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REPORT ON MARS, No. 10.

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In the previous Reports on Mars frequent mention has been made of the Martian Date, and in future reports, as we come to study more and more the seasonal changes on the planet, the term will very frequently be employed. Since its usage in astronomical literature is necessarily not very extended, a few words may be said with regard to it. It was first proposed and used by Professor Douglass in the Annals of the Lowell Observatory, Vol. 2. It is derived directly from the martian longitude of the sun ☉, given in the Ephemeris, which in turn differs from the heliocentric longitude of the planet by the constant 87°.7. As previously used by the writer it is defined in Report No. 2 under the name Equivalent Terrestrial Date, as he was not at that time aware that the quantity had been previously suggested, employed, and named by Professor Douglass. As there defined the Martian Date of March 20 begins when the solar longitude ☉ reaches 0°.0. The martian orbit is divided into 365 equal angular divisions, and the date increases directly in proportion to ☉, regardless of the eccentricity of the orbit of the planet.

While the martian date has proved very useful in the past, as far as it went, in giving us an idea of what portion of the planet's year any event took place, as for instance the flooding of the Syrtis Major on the martian date of April 12, observed by us January 17 and 18, 1914, yet there is the distinctly inconvenient feature of the quantity that it necessarily bears no relation to the number of martian days elapsed. Thus to travel in its orbit between the martian dates of May 1 and May 31 the planet requires 68 terrestrial days, or about 66 martian ones. Again to traverse the equal interval between November 1 and December 1, on the other side of its orbit, the planet requires only 47 martian days. Clearly the quantity as thus defined, could only be considered as a provisional one, and justified merely by the fact that there was nothing better to be had. To remedy this defect the writer

has computed a table based on the length of the martian day, and corrected for the eccentricity of the planet's orbit. This table he herewith presents in the form of a calendar for the planet.

In the construction of the terrestrial calendar two conditions are of vital consequence: (*a*) That the length of the calendar day and of the mean solar or civil day should be identical, in order that for business purposes the calendar day should always begin at the same hour, namely midnight. (*b*) The number of days in the year should be so adjusted that the vernal equinox should always come on about the same date, and the seasons should therefore remain the same. Since the year does not contain an integral number of days, this latter result is maintained by means of the additional day occasionally added in February, with its various complications.

In constructing a calendar for another planet it is most desirable that all complications should be reduced to a minimum. Since the martian year contains 668.6 martian solar days, it is evident that the leap years would give considerable trouble. Since we do not live on Mars, however, condition (*a*) may be neglected, and we may consequently divide the martian year into exactly 669 calendar days. This will not only entirely avoid the trouble of leap year, but will make our calendar quite independent of any future changes that observation may suggest in the length of the martian sidereal day. Unlike the case of the Earth, the calendar day will then begin all over the planet at the same instant of time. The lengths of the three martian days are therefore:—

Sidereal day [Marth]	24^h	37^m	$22^s.65$
Calendar day	24	38	42 .04
Mean solar day (civil)	24	39	35 .19

The first is the true period of rotation of the planet, from which its ephemeris is computed, the second the period by which we date our observations, while the last is the most important of all to the inhabitants of Mars, and is the one by which they control their daily life, but is of no consequence whatever to us. The calendar day, it will be seen, is only $53^s.15$ shorter than their mean solar day, and at no time in the year introduces a greater deviation in the revised martian date than 0.2 of a day. The martian calendar day equals 1.0269 terrestrial mean solar days, and the terrestrial mean solar day is 0.9738 martian calendar days.

With these fundamental questions settled, we may at once consider the more or less arbitrary questions involved in the construction of a calendar. The general principle borne clearly in mind in its construction has been that it should resemble our own as closely as possible without becoming too complex. The year has therefore been divided

into twelve months, the first nine months each containing 56 martian days, and the last three 55. The week now becomes a convenient unit, when we do not wish to be too precise in our specifications, and we have the rule that 7 days make a week, 8 weeks make a month, and 12 months make a year, one day being dropped from the last week of the last three months.

In approximating the martian calendar to our own, it is a convenient circumstance that the northern winter solstice and the perihelion are similarly situated in so far as their being near together is concerned, for both planets. For the earth the latter follows the former by 11°.5, for Mars it precedes it by 23°.3. In order that the three short months should cluster about perihelion they have been placed at the end of the year.

On account of the great eccentricity of the martian orbit, the martian date will sometimes get several days ahead of our own, and sometimes fall several days behind it. This might have been remedied by making the martian months of different lengths, but there would still have remained the difficulty of the greater number of days in each month. It was therefore thought best to avoid all complications and adopt the present plan. To make this excess and deficit of the martian date as nearly equal as possible, it was necessary to decide what day of the month we should assign to the martian equinox. It appears that equality can be nearly secured by adopting the convenient date of March 1.

TABLE I

MARTIAN CALENDAR.

Day	☉	Martian	Terrestrial	Day	☉	Martian	Terrestrial
	°				°		
1	0.0	Mar. 1	Mar. 20	25	11.9	Mar. 25	Apr. 1
2	0.5	2	"	26	12.4	26	"
3	1.0	3	21	27	12.9	27	2
4	1.5	4	"	28	13.3	28	"
5	2.0	5	22	29	13.8	29	3
6	2.5	6	"	30	14.3	30	"
7	3.0	7	23	31	14.8	31	4
8	3.5	8	"	32	15.3	32	"
9	4.0	9	24	33	15.8	33	5
10	4.5	10	"	34	16.3	34	"
11	5.0	11	25	35	16.8	35	6
12	5.5	12	"	36	17.3	36	"
13	6.0	13	26	37	17.7	37	7
14	6.5	14	"	38	18.3	38	"
15	7.0	15	27	39	18.7	39	8
16	7.5	16	"	40	19.2	40	"
17	8.0	17	28	41	19.7	41	9
18	8.5	18	"	42	20.2	42	"
19	9.0	19	29	43	20.6	43	10
20	9.5	20	"	44	21.1	44	"
21	10.0	21	30	45	21.6	45	11
22	10.5	22	"	46	22.0	46	"
23	11.0	23	31	47	22.5	47	12
24	11.4	24	"	48	23.0	48	"

MARTIAN CALENDAR—CONTINUED.

Day	⊙	Martian	Terrestrial
	°		
49	23.5	Mar. 49	Apr. 13
50	24.0	50	"
51	24.5	51	14
52	24.9	52	"
53	25.4	53	15
54	25.9	54	"
55	26.3	55	"
56	26.8	56	16
57	27.3	Apr. 1	"
58	27.8	2	17
59	28.3	3	"
60	28.7	4	18
61	29.1	5	"
62	29.6	6	19
63	30.1	7	"
64	30.5	8	20
65	31.0	9	"
66	31.5	10	21
67	31.9	11	"
68	32.4	12	22
69	32.9	13	"
70	33.3	14	23
71	33.8	15	"
72	34.3	16	24
73	34.7	17	"
74	35.2	18	25
75	35.7	19	"
76	36.1	20	"
77	36.6	21	26
78	37.1	22	"
79	37.5	23	27
80	38.0	24	"
81	38.4	25	28
82	38.8	26	"
83	39.3	27	29
84	39.8	28	"
85	40.2	29	30
86	40.7	30	"
87	41.2	31	May 1
88	41.6	32	"
89	42.1	33	2
90	42.5	34	"
91	42.9	35	"
92	43.4	36	3
93	43.9	37	"
94	44.3	38	4
95	44.8	39	"
96	45.3	40	5
97	45.7	41	"
98	46.2	42	6
99	46.6	43	"
100	47.0	44	7
101	47.5	45	"
102	48.0	46	8
103	48.4	47	"
104	48.9	48	9
105	49.4	49	"
106	49.8	50	10
107	50.3	51	"
108	50.7	Apr. 52	May 11
109	51.1	53	"
110	51.6	54	"
111	52.1	55	12
112	52.5	56	"
113	53.0	May 1	13
114	53.5	2	"
115	53.9	3	14
116	54.4	4	"
117	54.8	5	15
118	55.2	6	"
119	55.7	7	16
120	56.2	8	"
121	56.6	9	17
122	57.1	10	"
123	57.5	11	18
124	57.9	12	"
125	58.4	13	19
126	58.8	14	"
127	59.2	15	"
128	59.7	16	20
129	60.2	17	"
130	60.6	18	21
131	61.1	19	"
132	61.6	20	22
133	62.0	21	"
134	62.5	22	23
135	62.9	23	"
136	63.3	24	24
137	63.8	25	"
138	64.3	26	25
139	64.7	27	"
140	65.2	28	26
141	65.6	29	"
142	66.0	30	"
143	66.5	31	27
144	66.9	32	"
145	67.3	33	28
146	67.8	34	"
147	68.3	35	29
148	68.7	36	"
149	69.2	37	30
159	69.7	38	"
151	70.1	39	31
152	70.6	40	"
153	71.0	41	June 1
154	71.4	42	"
155	71.9	43	2
156	72.4	44	"
157	72.8	45	3
158	73.3	46	"
159	73.7	47	4
160	74.1	48	"
161	74.6	49	"
162	75.0	50	5
163	75.4	51	"
164	75.8	52	6
165	76.2	53	"
166	76.7	54	7

MARTIAN CALENDAR—CONTINUED.

Day	⊙	Martian	Terrestrial	Day	⊙	Martian	Terrestrial
	°				°		
167	77.1	May 55	June 7	228	105.1	July 4	July 6
168	77.5	56	"	229	105.6	5	7
169	78.0	June 1	8	230	106.0	6	"
170	78.4	2	"	231	106.5	7	8
171	78.9	3	9	232	107.0	8	"
172	79.4	4	"	233	107.4	9	9
173	79.8	5	10	234	107.9	10	"
174	80.2	6	"	235	108.4	11	10
175	80.7	7	11	236	108.8	12	"
176	81.2	8	"	237	109.3	13	11
177	81.6	9	12	238	109.8	14	"
178	82.1	10	"	239	110.3	15	12
179	82.5	11	13	240	110.8	16	"
180	83.0	12	"	241	111.3	17	13
181	83.5	13	14	242	111.7	18	"
182	83.9	14	"	243	112.2	19	14
183	84.3	15	15	244	112.7	20	"
184	84.8	16	"	245	113.1	21	15
185	85.2	17	16	246	113.6	22	"
186	85.7	18	"	247	114.1	23	16
187	86.2	19	17	248	114.5	24	"
188	86.6	20	"	249	115.0	25	17
189	87.1	21	18	250	115.5	26	"
190	87.6	22	"	251	116.0	27	18
191	88.0	23	"	252	116.5	28	"
192	88.4	24	19	253	117.0	29	19
193	88.9	25	"	254	117.4	30	"
194	89.3	26	20	255	117.9	31	20
195	89.8	27	"	256	118.4	32	"
196	90.3	28	21	257	118.9	33	21
197	90.7	29	"	258	119.4	34	"
198	91.2	30	22	259	119.9	35	22
199	91.7	31	"	260	120.4	36	"
200	92.1	32	23	261	120.9	37	23
201	92.5	33	"	262	121.4	38	"
202	93.0	34	24	263	121.8	39	24
203	93.4	35	"	264	122.3	40	"
204	93.9	36	25	265	122.8	41	25
205	94.4	37	"	266	123.2	42	"
206	94.8	37	26	267	123.7	43	26
207	95.3	39	"	268	124.2	44	"
208	95.8	40	27	269	124.7	45	27
209	96.2	41	"	270	125.2	46	"
210	96.7	42	28	271	125.7	47	28
211	97.2	43	"	272	126.1	48	"
212	97.6	44	29	273	126.6	49	29
213	98.1	45	"	274	127.1	50	"
214	98.6	46	30	275	127.6	51	30
215	99.0	47	"	276	128.1	52	"
216	99.5	48	July 1	277	128.7	53	31
217	100.0	49	"	278	129.2	54	Aug. 1
218	100.4	50	"	279	129.7	55	"
219	100.5	51	2	280	130.2	56	2
220	101.4	52	"	281	130.7	Aug. 1	"
221	101.8	53	3	282	131.2	2	3
222	102.3	54	"	283	131.7	3	"
223	102.8	55	4	284	132.2	4	4
224	103.2	56	"	285	132.7	5	"
225	103.7	July 1	5	286	133.2	6	5
226	104.2	2	"	287	133.7	7	"
227	104.6	3	6	288	134.2	8	6

MARTIAN CALENDAR—CONTINUED.

Day	⊙	Martian	Terrestrial
289	134.7°	Aug. 9	Aug. 6
290	135.2	10	7
291	135.7	"	"
292	136.2	12	8
293	136.7	"	"
294	137.2	14	9
295	137.8	15	10
296	138.3	16	"
297	138.8	17	11
298	139.3	18	"
299	139.8	19	12
300	140.3	20	"
301	140.8	21	13
302	141.3	22	"
303	141.8	23	14
304	142.4	24	"
305	142.9	25	15
306	143.4	26	"
307	144.0	27	16
308	144.5	28	17
309	145.0	29	"
310	145.5	30	18
311	146.0	31	"
312	146.5	32	19
313	147.1	33	"
314	147.6	34	20
315	148.1	35	"
316	148.7	36	21
317	149.3	37	22
318	149.8	38	"
319	150.4	39	23
320	150.9	40	"
321	151.4	41	24
322	152.0	42	"
323	152.5	43	25
324	153.0	44	"
325	153.6	45	26
326	154.1	46	27
327	154.6	47	"
328	155.2	48	28
329	155.7	49	"
330	156.2	50	29
331	156.8	51	"
332	157.3	52	30
333	157.9	53	"
334	158.5	54	31
335	159.0	55	Sept. 1
336	159.5	56	"
337	160.1	Sept. 1	2
338	160.6	2	"
339	161.1	3	3
340	161.7	4	"
341	162.2	5	4
342	162.8	6	5
343	163.4	7	"
344	163.9	8	6
345	164.4	9	"
346	165.0	10	7
347	165.5	11	"
348	166.2	12	8
349	166.8	13	9
350	167.3°	Sept. 14	Sept. 9
351	167.9	15	10
352	168.5	16	"
353	159.0	17	11
354	169.5	18	"
355	170.1	19	12
356	170.6	20	13
357	171.3	21	"
358	171.9	22	14
359	172.4	23	"
360	173.0	24	15
361	173.6	25	16
362	174.1	26	"
363	174.7	27	17
364	175.3	28	"
365	175.8	29	18
366	176.4	30	19
367	177.0	31	"
368	177.6	32	20
369	178.2	33	"
370	178.8	34	21
371	179.3	35	"
372	179.9	36	22
373	180.5	37	23
374	181.1	38	"
375	181.7	39	24
376	182.3	40	25
377	182.9	41	"
378	183.5	42	26
379	184.1	43	"
380	184.7	44	27
381	185.3	45	28
382	185.9	46	"
383	186.5	47	29
384	187.1	48	"
385	187.7	49	30
386	188.3	50	Oct. 1
387	188.9	51	"
388	189.5	52	2
389	190.1	53	"
390	190.7	54	3
391	191.3	55	4
392	191.9	56	"
393	192.5	Oct. 1	5
394	193.1	2	6
395	193.7	3	"
396	194.3	4	7
397	195.0	5	"
398	195.6	6	8
399	196.2	7	9
400	196.8	8	"
401	197.4	9	10
402	198.0	10	11
403	198.7	11	"
404	199.3	12	12
405	199.9	13	"
406	200.6	14	13
407	201.2	15	14
408	201.8	16	"
409	202.4	17	15
410	203.0	18	16

MARTIAN CALENDAR—CONTINUED.

Day	⊙	Martian	Terrestrial
411	203.6°	Oct. 19	Oct. 16
412	204.3	20	17
413	204.9	21	"
414	205.5	22	18
415	206.2	23	19
416	206.8	24	"
417	207.4	25	20
418	208.0	26	21
419	208.6	27	"
420	209.2	28	22
421	209.9	29	"
422	210.5	30	23
423	211.1	31	24
424	211.8	32	"
425	212.4	33	25
426	213.0	34	26
427	213.7	35	"
428	214.3	36	27
429	214.9	37	28
430	215.6	38	"
431	216.2	39	29
432	216.8	40	"
433	217.5	41	30
434	218.1	42	31
435	218.7	43	"
436	219.4	44	Nov. 1
437	220.0	45	2
438	220.6	46	"
439	221.3	47	3
440	221.9	48	4
441	222.6	49	"
442	223.3	50	5
443	223.9	51	"
444	224.5	52	6
445	225.2	53	7
446	225.8	54	"
447	226.4	55	8
448	227.1	Nov. 1	9
449	227.7	2	"
450	228.4	3	10
451	229.1	4	11
452	229.7	5	"
453	230.3	6	12
454	231.0	7	13
455	231.6	8	"
456	232.2	9	14
457	232.9	10	"
458	233.5	11	15
459	234.2	12	16
460	234.9	13	"
461	235.5	14	17
462	236.1	15	18
463	236.8	16	"
464	237.4	17	19
465	238.0	18	20
466	238.7	19	"
467	239.3	20	21
468	240.0	21	"
469	240.7	22	22
470	241.3	23	23
471	241.9	24	"
472	242.6°	Nov. 25	Nov. 24
473	243.2	26	25
474	243.8	27	"
475	244.5	28	26
476	245.1	29	27
477	245.8	30	"
478	246.5	31	28
479	247.1	32	"
480	247.7	33	29
481	248.4	34	30
482	249.0	35	"
483	249.7	36	Dec. 1
484	250.4	37	2
485	251.0	38	"
486	251.7	39	3
487	252.4	40	4
488	243.0	41	"
489	253.6	42	5
490	254.3	43	6
491	254.9	44	"
492	255.5	45	7
493	256.2	46	"
494	256.9	47	8
495	257.6	48	9
496	258.2	49	"
497	258.9	50	10
498	259.5	51	11
499	260.1	52	"
500	260.8	53	12
501	261.5	54	13
502	262.1	55	"
503	262.8	Dec. 1	14
504	263.5	2	15
505	264.1	3	"
506	264.8	4	16
507	265.5	5	17
508	266.1	6	"
509	266.8	7	18
510	267.4	8	19
511	268.0	9	"
512	268.7	10	20
513	269.3	11	"
514	269.9	12	21
515	270.6	13	22
516	271.2	14	"
517	271.8	15	23
518	272.5	16	"
519	273.1	17	24
520	273.7	18	25
521	274.4	19	"
522	275.0	20	26
523	275.6	21	27
524	276.3	22	"
525	276.9	23	28
526	277.5	24	"
527	278.2	25	29
528	278.8	26	30
529	279.4	27	"
530	280.1	28	31
531	280.7	29	"
532	281.3	30	Jan. 1

MARTIAN CALENDAR—CONTINUED.

Day	⊙	Martian	Terrestrial	Day	⊙	Martian	Terrestrial
533	282.0°	Dec. 31	Jan. 2	594	319.0°	Jan. 37	Feb. 7
534	282.6	32	"	595	319.5	38	8
535	283.2	33	3	596	320.1	39	"
536	283.9	34	4	597	320.7	40	9
537	284.5	35	"	598	321.2	41	"
538	285.1	36	5	599	321.8	42	10
539	285.8	37	"	600	322.4	43	"
540	286.4	38	6	601	322.9	44	11
541	287.0	39	7	602	323.5	45	12
542	287.7	40	"	603	324.1	46	"
543	288.3	41	8	604	324.6	47	13
544	288.9	42	9	605	325.2	48	"
545	289.6	43	"	606	325.8	49	14
546	290.2	44	10	607	326.3	50	"
547	290.8	45	"	608	326.9	51	15
548	291.4	46	11	609	327.5	52	16
549	292.0	47	12	610	328.0	53	"
550	292.6	48	"	611	328.6	54	17
551	293.3	49	13	612	329.2	55	"
552	293.9	50	"	613	329.7	56	18
553	294.5	51	14	614	330.3	Feb. 1	"
554	295.1	52	15	615	330.9	2	19
555	295.7	53	"	616	331.4	3	"
556	296.3	54	16	617	332.0	4	20
557	296.9	55	"	618	332.6	5	21
558	297.5	Jan. 1	17	619	333.1	6	"
559	298.1	2	18	620	333.7	7	22
560	298.8	3	"	621	334.2	8	"
561	299.4	4	19	622	334.7	9	23
562	300.0	5	"	623	335.3	10	"
563	300.6	6	20	624	335.9	11	24
564	301.2	7	21	625	336.4	12	"
565	301.8	8	"	626	337.0	13	25
566	302.4	9	22	627	337.5	14	"
567	303.0	10	"	628	338.0	15	26
568	303.6	11	23	629	338.6	16	27
569	304.2	12	24	630	339.1	17	"
570	304.8	13	"	631	339.6	18	28
571	305.4	14	25	632	340.2	19	"
572	306.0	15	"	633	340.7	20	Mar. 1
573	306.6	16	26	634	341.2	21	"
574	307.2	17	27	635	341.8	22	2
575	307.8	18	"	636	342.3	23	"
576	308.4	19	28	637	342.8	24	3
577	309.0	20	"	638	343.4	25	"
578	309.6	21	29	639	343.9	26	4
579	310.2	22	"	640	344.4	27	"
580	310.8	23	30	641	345.0	28	5
581	311.4	24	31	642	345.5	29	"
582	312.0	25	"	643	346.0	30	6
583	312.6	26	Feb. 1	644	346.6	31	7
584	313.2	27	"	645	347.1	32	"
585	313.8	28	2	646	347.6	33	8
586	314.3	29	"	647	348.1	34	"
587	314.9	30	3	648	348.6	35	9
588	315.5	31	4	649	349.1	36	"
589	316.1	32	"	650	349.7	37	10
590	316.7	33	5	651	350.2	38	"
591	317.3	34	"	652	350.7	39	11
592	317.8	35	6	653	351.3	40	"
593	318.4	36	7	654	351.8	41	12

MARTIAN CALENDAR—CONTINUED.

Day	⊙	Martian	Terrestrial	Day	⊙	Martian	Terrestrial
655	352°.3	Feb. 42	Mar. 12	663	356°.5	Feb. 50	Mar. 16
656	352.8	43	13	664	357.0	51	17
657	353.3	44	"	665	357.5	52	"
658	353.8	45	14	666	358.0	53	18
659	354.4	46	"	667	358.5	54	"
660	354.9	47	15	668	359.0	55	19
661	355.4	48	"	669	359.5	56	"
662	356.0	49	16				

In Table I the four successive columns give the day of the year, the solar longitude ⊙, and the equivalent martian and terrestrial dates. The martian dates are exact year after year, but owing to the leap year the terrestrial ones change through a range of about one degree. Every date begins with the longitude given in the table, and lasts until the following longitude, thus March 1 begins at solar longitude 0°.0, and lasts until 0°.5. In order to compare the martian and terrestrial dates when they are not in the same month, convert the terrestrial date into the previous month by adding 28, 30, or 31 days as may be necessary. Table II gives the deviation on different martian dates.

TABLE II

M.D.	M-T	M.D.	M-T	M.D.	M-T	M.D.	M-T
Mar. 56	+ 9	Apr. 1	−15	Sept. 56	+22	Oct. 1	− 4
Apr. 56	+14	May 1	−12	Oct. 55	+16	Nov. 1	− 8
May 56	+18	June 1	− 7	Nov. 55	+12	Dec. 1	−13
June 56	+22	July 1	− 4	Dec. 55	+ 8	Jan. 1	−16
July 56	+23	Aug. 1	− 1	Jan. 56	+ 7	Feb. 1	−17
Aug. 56	+24	Sept. 1	− 1	Feb. 56	+ 9	Mar. 1	−19

It will be noticed by the first two columns that at the end of every month throughout the year the martian date is in excess, but the effect of their long months is such that on the next day, the beginning of the new month, as shown by the two remaining columns, it is always behind the corresponding terrestrial date. The maximum deviations are +24 and −19 days. On the following dates the calendars coincide: April 30, May 23, 24, June 14, 15, July 8, 9, August 3, 4, September 2, 3, October 11, 12, November 21, 22. There is of course no necessity that the two calendars should be identical throughout, but it is desirable that they should not differ very widely. The important thing is that the Martian Date should always mean the same thing. This calendar will be used in all of our future reports.

The following important dates are the same every martian year:—

Vernal Equinox	⊙ = 0°.0	March	1.0
Summer solstice	90 .0	June	27.4
Autumnal equinox	180 .0	September	36.2
Winter solstice	270 .0	December	12.1
Perihelion	246 .7	November	31.3
Aphelion	66 .7	May	31.5

In Report No. 7 attention was called to the fact that all the ephemerides of Mars for the coming opposition were using the erroneous value for the diameter found by Peirce of 10″.11. It is understood that the Washington authorities are now considering a revision of this figure. In order to make this point a little clearer the writer has investigated the matter further since his former publication. In Flammarion's Mars **1**, 504 is given a table giving all the published diameters of the planet prior to 1893. Peirce's value is based on meridian observations,—an obviously inaccurate method. Since 1850 five such results have been published by different authorities of which the mean is 10″.29 ± 0″.50. Since 1860 thirteen different results have been published based on micrometer measurements. The mean is 9″.37 ± 0″.08, thus reducing the average deviation fully six times. The large systematic error of the meridian observations is doubtless due chiefly to irradiation. The value found at the Lowell Observatory 9″.35 (Annals Lowell Observatory **1**, 75), is based on the measures of three observers taken in 1894, when the planet was unusually near us. It appeared too late to be given in Flammarion's list. The value used at Greenwich for many years past, and only abandoned the present year was 9″.36.

The only quantities in the Ephemeris affected are the diameter d, and the maximum defect of illumination q. Neither are very important, and both can be readily corrected by subtracting 1/14, or more accurately 1/13.6. Using the diameter 9″.36 and the solar parallax 8″.80, the diameter of the planet becomes 4216 miles or 6784 kilometers. The value of 1° of latitude is 36.79 miles, or 59.20 kilometers.

Since the coming opposition of Mars, as well as the one that is just past, should, according to Schiaparelli, be favorable to seeing the duplication of the canals, a few words may be said in this place on the subject. According to his Memoir **3**, 367 seventeen canals were first seen double in 1882 between the dates of January 19 and February 19, or between 40 and 71 terrestrial days after the vernal equinox of Mars, which fell on December 10, 1881. This would correspond to between 39 and 69 martian calendar days, which by Table I we see correspond to solar longitudes 18°.7 and 32°.9, and to the martian dates March 39 and April 13. Mean longitude 25°.8. Mean date March 53.

Again according to his Memoir **6**, 106 the middles of the two duplication periods occur three terrestrial months before, and five terrestrial months after the martian summer solstice. This would correspond to 91 terrestrial or 88 martian calendar days before the solstice. The solstice occurs June 27, or day 195 according to the calendar. The duplication day would therefore be 107, the solar longitude 50°.3, and the martian date April 51. In the Lowell Bulletin **15**, and in Report **5**

the solar longitude is given as 50°. The second day of duplication is 343, the corresponding solar longitude 163°.4 and the martian date September 7. The value previously given was 165°.

We thus find two values of the solar longitude ⊙ for the first duplication, 25°.8 and 50°.3. The first of these gives the average time when the canals were first seen to duplicate, the second the supposed middle of the duplication. Schiaparelli assumes that three terrestrial months after the martian vernal equinox are the same thing as three terrestrial months before the summer solstice. On account of the eccentricity of the martian orbit the deviation is considerable, and as shown by the Table would bring the mean date of duplication back to calendar day 88, corresponding to solar longitude 41°.6 and to the martian date April 32 instead of April 51. In 1914 the terrestrial dates corresponding to solar longitudes 25°.8 and 41°.6 were January 24 and February 28. At the coming opposition they are December 12, 1915 and January 16, 1916.

In 1914 the first date came but 19 days after opposition. According to Schiaparelli, the separation ranged from 4° to 12°, or from 150 to 440 miles, distances which would have been conspicuous to Messrs Phillips, Douglass, and the writer, yet none of us more than vaguely suspected a duplication, as recorded in Reports Nos. 5 and 8. Duplications, as is well known, are constantly seen by Messrs. Lowell and Slipher. Using the second duplication date as the more favorable, the doubling should be well seen this year if it exists. The middle date occurs twenty-four days before opposition, and the duplication should continue for about one month after it.

While these facts do not appear very favorable to the detection of the duplication by the first three observers at the coming opposition, yet there are certain facts to be considered on the other side of the question. The 17 canals which were seen double between the specified dates in 1882 were Acheron, Antaeus, Avernus, Cyclops, Erebus, Eumenides, Eunostos, Euphrates, Ganges, Gehon, Gigas, Hephaestus, Jamuna, Orcus, Phison, Thoth, and Typhon. Only three of these canals, Eunostos, Hephaestus and Thoth, were clearly seen in Jamaica the past year, nine others were faintly seen at different times, while the remaining five were not seen at all.

As pointed out in Report No. 8, several of the canals which the Lowell Observatory reported as double (there were twelve of them), were seen of the same breadth by the other observers, the only difference being that the latter did not see any bright streak running down the middle of the canal. On looking for such a streak the writer on two evenings vaguely suspected it, but concluded in both cases that what he saw was probably merely a contrast effect, caused by the dark

band of the canal crossing a bright background, and thus making its edges appear darker than its middle. It appears to the writer that when the canals begin to fade out, it is possible that the middles may in some cases fade first. There would be nothing particularly surprising if this were so. It seems the more likely since this is just what happens in the case of the double canal in Aristillus, and also in a more conpicuous way to a canal or dark band lying along the eastern rim of the crater Eratosthenes. This band first appears at about colongitude 120°, begins to divide the next night, and is clearly divided into two dark lines, parallel for part of their length, at colongitude 148°. With a low power the canal of this double are as straight, uniform, and artificial looking as anything seen upon Mars.

Another reason why the writer has not given up all hope of seeing the duplication is a statement which the late Major Molesworth made after the opposition of 1901. In that opposition Mars was in the same portion of its orbit that it will be in this coming winter. Major Molesworth was one of the most skilful observers since Schiaparelli, and he worked under very favorable conditions in Ceylon, with a 12-inch reflector. He writes: "The gemination of Martian canals appears to be real, and not illusive, and, I think, is due, in almost every case, to the existence and variable visibility of two almost parallel, distinct canals; sometimes one canal, sometimes both being visible... When both canals are seen, the space between them is generally slightly shaded, and this shaded streak often gives the impression of a single, broad, diffuse canal, when the darker edgings are not seen." (Memoirs Brit. Astron. Assoc. **11**, 89.)

In our last Report we described the precautions which should be taken in recording the colors exhibited by the planet. We shall now describe our own results and also those which some other observers obtained at the past opposition. In most of our work we employed an incandescent carbon filament as the source of illumination, but in a number of cases a 2 c.p. tungsten lamp was used, and a few paintings were made by daylight. As pointed out in Report No. 9, in future observations we should use a very blue source of light to illumine our paper. A 25 c.p. tungsten light shining through light blue glass was recommended. The writer has since learned from Dr. Mees of the Eastman Kodak Co., that he has prepared a gelatin film of the proper color to give the effect of sunlight. The Artificial Daylight Co., of New York, prefer blue glass of a standard color to give the same result, so that observers at the coming opposition can readily furnish themselves with a suitably colored medium to meet their requirements.

The desert regions furnish the largest areas of one color upon the planet, and their color is the one most affected by the source of illumin-

ation. If the paper is illumined by a carbon filament, and examined through a round hole of the proper size in a black mask placed in contact with the paper, the color of these portions of the planet will be found to range between pure white and yellow ochre. If viewed by either a redder or bluer light, their color will become redder. It is very certain that it is subject to change, in part owing to the presence of more or less invisible martian cloud, and in part to a real change of surface. A change of color was also suggested by Schiaparelli. (Flammarion 1, 356). It is not clear why a redder illumination should cause us to paint the disk redder, but such seems to have been the fact for at least two observers. If painted by daylight the disk appears very much redder, owing to the blue illumination of our paper by the sky, but it is still probably not red enough, as is shown in Report No. 9, owing to the blue light coming to us from that portion of our atmosphere lying between us and the planet.

The greens on Mars, which are occasionally even more prominent than the yellows, are of about the color of our own vegetation when seen at a distance of a mile or so on a clear day. Under tungsten illumination they are paler, as might be expected, than when the paper is illuminated by the carbon filament. Occasionally some very vivid greens are seen in the polar cap or along the limb, which are not easy to explain. They are subject to sudden variations from night to night, were most frequently seen at dawn or twilight early in the martian season, before the snow had replaced the clouds, and are probably due to some subjective effect. Sometimes the limb would be described as green, yet when the rotation brought the region nearer the center of the disk the color would have entirely vanished. Something similar, though less vivid, has been seen upon the moon, when the snow was forming on Pico (Popular Astronomy, March, 131). Something analogous indeed has been seen also in the case of our own clouds. If we examine some that are fairly dense, using a magnification of about 400, and protecting our eyes from the glare by neutral tinted glasses, we shall find that to represent the color on paper we shall sometimes have to use a distinctly greenish colored crayon. Often on the other hand they appear of nearly the same color that they do to the naked eye or with a low power, drab or neutral tint. Without the shade glasses the light is so bright that little color can be detected.

These subjective greens are certainly puzzling, but they are not to be confounded with the real greens seen upon Mars which last for months at a time, are clearly seasonal, and are most conspicuous at some distance from the limb. They first appeared at this past opposition on November 17, 1913, when the southern dark areas Cimmerium and Sirenum are described as distinctly greener than those to the north.

The corresponding longitude of the Sun was 353°.3, and the martian date February 44. On the martian date of February 34, it is recorded that no green was visible in Cimmerium. The date of the appearance of the first real green this year is therefore pretty closely fixed, but it will be noted that it was found in the southern hemisphere, in latitude −30°, and therefore appeared in their autumn, at the close of their hot dry summer, as soon as the moisture from the opposite polar cap reached it.

From this date on, with one exception, clearly marked greens were constantly recorded in the southern hemisphere, but though dark areas were visible in the north for much of the time, and it was the spring of their year, they always appeared of a colorless grey, in strong contrast to the southern regions. During the opposition of 1890 these same southern regions were painted green at the time of their spring. At the opposition of 1892 they were several times noted as greenish or greenish grey, but although it was their spring time, it is clear that the green was by no means as pronounced nor as continuous as at the past opposition, corresponding to their autumn.

The northern region Acidalium Mare, between the martian dates of September 20 and 22, that is just before the autumnal equinox, also appeared green in 1890. Also in 1892 the northern portion of the Syrtis Major was several times noted as greenish gray, at about this same season. The north pole itself was also frequently greenish in 1892. There appears therefore to be evidence of some green in these portions of the northern hemisphere during their autumn. It appears then in general that it is in autumn rather than in the spring time that vegetation bursts forth, and is at its greenest upon Mars.

Beginning with Cimmerium during the past opposition the greens were recorded all the way around the planet in that same latitude, with the exception of a break in the region south of Sabaeus. Although represented as greenish December 2, it was recorded as grey when other neighboring regions were green, upon the nights of November 30 and December 3, 8, and 10. Grey was therefore probably its real color at this time. When next seen, January 6, Deucalionis was pale, but Pandorae was a clear vivid green. The grey color previously seen may have been due to martian haze, or the vegetation there may have been a little different from that in the other longitudes and have required a little longer time to develop.

In the other regions described as greenish the color rapidly increased in intensity, so that by December 3 it is recorded as "more pronounced than heretofore," and the next night it was painted as a bright vivid green. This bright color was maintained throughout the period of observation, except when concealed by martian haze, and as late as

May 8, corresponding to the martian date of May 43, it is recorded that the maria were as green as in the painting of December 4, corresponding to March 4. The diameter of the planet at this time was reduced to only 5″.9.

The blue color appeared in Acidalium very suddenly on November 30, when it was described as "a blue grey, the blue clearly marked, and different from anything else on the disk." The corresponding martian date was February 56. Two days previously the same region was the same shade as the other greys, although darker. This was the chief blue area upon the planet, and except when interrupted by terrestrial or martian clouds retained its color for nearly five months, for as late as April 21 it was still described as bluish, although the diameter of the planet was then reduced to 6″.5. Other blue polar areas were Boreosyrtis and the twin bays that appeared near Propontis.

The appearance of the temporary blue marsh at the northern extremity of the Syrtis Major on January 17 has been already described in our Report No. 4. The equivalent martian date was March 47. All these blues faded sooner or later into greys, not into browns, as had been observed on a former occasion in 1894.

The two most striking brown areas, Cerberus and Sabaeus, were like the blue areas of small size. The first time the color of the former was clearly seen, December 16, it was pronounced brown, and at the last observation March 5 it was still of the same color. The first time the color of Sabaeus was recorded, November 30, it was described as grey. By January 6 it had turned to a clear chocolate brown, and was still of that color February 12, but a few days later was described as grey, and on March 21 as brown or grey. The planet was then only 8″.3 in diameter. At intermediate dates both areas were frequently described as brown. On February 5 Lunae Lacus was first seen as a large brown area. It was also seen of the same color on February 6 and 7, but returned to its grey hazy condition on February 8, 10, and 12. The spot was again detected on March 15 and April 21, but its color was not noted.

In 1892, May 9, Sabaeus was described as grey. The equivalent martian date was September 23. By June 6, equivalent to September 50, it was bluish grey. By July 11, equivalent to October 27, it was a clear light blue. By August 15, equivalent to November 8, it is described as brownish grey without a trace of blue. It appears therefore that soon after the southern polar cap begins to melt Sabaeus shares with the Syrtis Major the fate of being temporarily converted into a marsh. When the northern cap melts only the Syrtis, as far as we have seen, becomes marshy, but there is some evidence that Sabaeus may do so later. It should be carefully watched this next year.

The region of the south pole was subject to marked changes of color and brightness. When first observed in July it was described as red, indicating a lack of vegetation. Later it turned yellow, indicating cloud. On one or two occasions it was thought to be white, indicating snow. On February 1 it was described as dark greenish grey, darker than the rest of the terminator, and on February 10 as bright greenish grey, not at all yellow, and brighter than any other region save the north polar cap.

After the melting of the southern polar cap there seems to be much more cloud in the atmosphere of Mars than there is after the northern cap melts. This cloud takes three forms: (*a*) That of a widely diffused general haze, which may either lie along the limb as a crescent, or may cover the whole surface of the planet. (*b*) Large brilliant cloud masses, several hundred or even thousand miles in length, lying along the terminator. (*c*) Minute individual cloudlets. In 1892 the latter were very numerous and easily seen. The conditions seemed much more nearly terrestrial than after the melting of the northern cap this past year, when some haze and large cloud masses, but comparatively few individual clouds, were visible.

While the clouds on Mars are usually yellow or yellowish, yet this is not always the case. On December 31 it is recorded that there was a whitish cloud at the south pole and along the terminator, while the limb itself was yellow and apparently clear. Clouds bounded all the dark details on the northern sides. February 7 the south pole was colorless and unusually bright, although much less so than the northern one. On February 13, central meridian 10°, Acidalium was blue and followed by a conspicuous white cloud reaching to the terminator. On February 15 and 16 the south polar and limb clouds were whitish. On March 15 the limb was white. Our own clouds are often by no means white even to the naked eye as compared with white paper, and might frequently be described as yellowish, yellowish grey or even brownish.

Venus when seen by daylight is of a strong lemon yellow color, very different indeed from that of the terrestrial clouds. This is not due to contrast with the blue sky, for if watched on a partly cloudy day, the yellow will still remain when the whole background owing to cloud has turned whitish, the color being entirely different from that of the background, and will persist until the planet becomes too faint to enable us to recognize any color at all. The magnifications employed in this study were 330 and 430. Jupiter also appears yellow, not white, but its light is comparatively faint. That the martian clouds sometimes appear of a much more distinct yellow color than anything of the sort that we have on the earth is undoubted, but that does not

prove that they would appear so if seen under similar circumstances to our own. To explain any of them as due to dust carried up into the air by martian winds, strikes the writer as improbable, first because they occasionally rise to a height of over 20 miles, and second because they then move very slowly, rarely if ever at a speed exceeding 20 miles per hour, and we cannot conceive of the thin martian atmosphere supporting coarse yellow dust under circumstances when it would be impossible even for our much denser terrestrial atmosphere to do so. The writer believes that these and all other martian clouds are like our own, due simply to condensed water vapor, and that their yellow appearance is due to our point of view, as explained in more detail in Monthly Report No. 4.

The limb of Mars is usually brighter than the center of the disk, but near opposition the effect is occasionally reversed. Thus on December 25 the limb as well as the terminator were darker than the centre. January 4 the limb was the same brightness and color as the center.

The next night was opposition, and on the following night the terminator was distinctly brighter than the limb. This was doubtless due to clouds on the terminator. It is surprising, however, considering how frequently clouds appear along the limb, that they so seldom appeared upon the terminator, this past year, even when the planet was near opposition. Consequently observations of this sort were very exceptional.

Among the contributions that the writer has received from his various correspondents interested in Mars, mention should be made in this place of some beautifully executed color studies by Father Algué of the Observatory of Manila, of the surface of the planet. They were made at the end of January and early in February, and in all of them the blues and greens are strongly shown, while even the yellows have a greenish tint. The central portions are often shown as reddish. Some very artistic color sketches have also been received from Mr. McEwen of Glasgow. They were painted by the light of an oil lamp, and the prominent colors are orange, red, violet, and drab. The red is often strongly marked. The lack of blues and greens is probably due to the source of illumination, drab and violet taking their place.

This is a somewhat neglected branch of astronomical research, perhaps because it requires a special training of the eye, and a capacity to see color that many people do not seem to possess. In connection with Mars, however, it should be by no means neglected, and it is hoped that others may be induced to take it up at subsequent oppositions.

ON THE SUGGESTED MOVEMENT OF THE CANALS OF MARS.

PERCIVAL LOWELL.

The suggestion that the canals of Mars move over the face of the planet seems to call for a word of comment. In the first place we must carefully distinguish between observation and interpretation. Now as to what was observed the phenomenon is not new, having been detected and recorded nineteen years ago at the Lowell Observatory. As to its interpretation further study of the planet there under the site's exceptional conditions revealed the cause of it, which was not movement at all but something quite different, to wit: the existence of many more canals than had till then been discovered and the varying individual visibility of each. The showing of some of these canals at one time and their apparent obliteration at a subsequent date, combined with the self-assertion of others, would result in just the apparent shift observed. This deduction was clinched by the eventual detection of both sets simultaneously. The reader will readily appreciate this by turning to the photographs of one of the Flagstaff globes of Mars and noting the canals in various regions, especially those in the neighborhood of the Solis Lacus. For such investigation the best of drawings are necessary, which is why the observatory was founded where it is.

Lowell Observatory.
July 1, 1915.

THE UNIVERSE.

CHARLES NEVERS HOLMES.

By Universe, we mean popularly as well as scientifically the sum-total of all Creation, or, in other words, the whole amount of material space that exists. With respect to spiritual conditions, to spiritual environments, such unmaterial conditions are not at all related to the Universe, as we designate it. For the Universe is an incalculable collection of ether-matter, governed by certain fixed laws, and everything that is not matter, not governed by material laws, has no relation to the Universe. In spiritual surroundings and associations most of us strongly believe; but such surroundings and associations—however powerfully they may influence us—however closely our destinies may be interwoven with them after death—are not at all a part of our Universe. For the Universe, as such, has solely to do with our mortal life, and is as widely separated from our immortal life as a dead body from its freed and departed soul.

But the term Universe has a far different meaning to one individual than it has to some other individual. Some of us think of it as limited in extent, just as our earth is limited; and others think of it as being illimitable, without breadth or bounds. Of course, each one of us has a perfect right to work out his own conclusions respecting problems of the Universe. There is no one of us possessing so titanic an intellect that, as yet, he can exclaim with absolute certainty—"Eureka!" But in discussing problems relative to the outer-Creation we should, as far as possible, free ourselves from all terrestrial narrowness. The fact that our tiny planet-world is limited in dimensions is no argument for denying that the stupendous Universe lying outside of it is illimitable.

Illimitable!—without bounds. Not circumscribed by a trillion, a quintillion, or even a thousand nonillion of miles! Just on and on forever, without a stop. No beginning, no ending. An eternal succession of Space to—infinity. What earth-educated mortal, whose ancestors have dwelt here thousands of years, can adequately comprehend an illimitable Universe? The human mind makes a brave attempt to launch itself boldly into the the abysmal gulf of sidereal space, and then suddenly remembers in full flight that it is, after all, only an earth-born mind. Terrestrial associations and comparisons limit the human intellect. That intellect must have something with which to

compare the Universe. It takes the earth as a yard-stick, so to speak, and the result is that most of us cannot believe that the creation of an Almighty Hand is without bounds—is illimitable.

But, considering the other side of this great question, let us ask ourselves if it is not possible that our Universe is finite. And if our Universe is finite, it must have a limit somewhere. But if the material Creation is limited, what lies beyond? Can the human mind conceive without a feeling of unrest that the Universe comes to an end, and an absolute obliteration begins which will never have an end. Can the mind believe it possible that complete nothingness is a positive fact? For example, take a case of an almost-vacuum, as near as we can obtain it, and then mentally increase that almost-vacuum to a real vacuum. Would such a real vacuum be absolute nothingness? We should say that a condition of absolute vacuum existed; but to reach absolute nihility we have to deal with a conception far more subtle than a terrestrial vacuum. An absolute vacuum would still be a material vacuum, whereas absolute nihility has no relation whatsoever to anything material.

Yet, if our Universe is finite, absolute nihility or some unknown quantity must surround its boundaries. If our Universe is limited, then, at some distance from the earth, more or less remote, all material conditions will cease and nihility or some unknown quantity will supersede. That is to say that ether and its atoms, and the laws governing them, in fact every condition with which we are associated and surrounded, will be completely obliterated, and Creation, as we know it, will be as non-existent as light amid utter darkness. Such nihility and obliteration could not be comprehended by the human mind, developed as it has been amid terrestrial surroundings where everything is tangible; such a theory would be one explanation of a finite Universe. With utter nonentity enclosing the stupendous sum-total of all Creation, the ether and its atoms, and the laws governing them, would come at last to a complete end—perhaps not abruptly but attenuating gradually into nothingness. This nonentity might possibly occur at an inconceivable remoteness from our planet and also from the Milky Way—the boundary of our local Universe. It may be that a number of associated suns and satellites besides those included within the confines of our Milky Way, are to be found amid the sum-total of all-Creation, and that nihility does not supersede until at a stupendous remoteness from the nearest of these. Also it may be that our own local Universe is the nearest of all such universe-groups to the limits of a finite Creation. However that may be, it is indeed an excellent plan to rid our minds of any idea that our earth occupies

about the center of all Creation, as well as of the innate belief that our world is somehow the most remarkable of planets.

But perhaps it may be that our still immature and earth-born minds simply cannot comprehend an illimitable Universe, and that after all our Universe is illimitable! Certainly an Almighty Hand that could create a Universe so vast that it contains the far-off Milky Way, and perhaps many more, even larger, Milky Ways, would be able to make that Universe utterly without limits. It is not, however, the possibility of such an illimitable Universe as it is the probability. After we plunge mentally many trillions of miles into the abyss of ether-space, it is easy to fly mentally some quadrillion of miles, and so on—*ad infinitum*. In writing numbers, like 1-2-3-4-5, etc., we could write forever, or in dividing 1 by 3 we could divide on indefinitely; but we never question the possibility of such number writing or such division, because they are both familiar to and understood by us. But the illimitable mileage of the Universe, although it consists merely in counting indefinitely miles or light years, is neither familiar to nor understood by us. Therefore, the limitless number of miles in all Creation that go on and on forever, just like we can count on and on, forever and forever, seem impossible to many of us, although, as we ponder upon this matter and become more and more familiar with it, the possibility rather than the impossibility of an illimitable Universe grows more and more evident.

Casting away completely our terrestrial narrowness and prejudices, and living for the moment amid the Universe itself, it does not seem so impossible that the Universe is illimitable. Is such a condition of unlimited space any more remarkable and impossible than that there should be so stupendous a domain of ether as that occupied by the Milky Way? Yet we gaze without surprise, without any doubt, upon the dimly shining band of the galaxy, considering its vast distance as a matter of course. Yet that vast distance is practically an illimitable one, from the standpoint of such a comparatively insignificant cipher as terrestrial man. Should he endeavor to walk that distance over the surface of the world he would die before he had made any noticeable progress. For, to mortal man, even though he is well versed in astronomical science, such remoteness as that from his planet to the Milky Way is incomprehensible, inconceivable. Such a stupendous distance is just as illimitable as the unlimited distance from the world out into the infinite Universe. Man is, however, more or less familiar with the Milky Way but he is not accustomed to pondering upon the boundless space beyond that Milky Way. Were he as used to the conception of an illimitable Universe beyond the galaxy as he is to the conception of a practically illimitable Universe within the Milky

Way, terrestrial man would never think of such a majestic work created by the Almighty as a finite work.

Does it not seem more like the potency and wisdom of the Omnipotent Architect to create a boundless rather than a limited Universe? Does it not seem more consistent and simpler for the ether to continue on an on indefinitely rather than to be surrounded by a nihility or an unknown quantity which we could not comprehend? Is it not far more natural to count forward, 1-2-3-4-5, etc., than backward, 5-4-3-2-1-0-0-0-0-0, ending in a cipher—in nothingness? Is it to be expected that the ordinary finite brain of man without studying the question long and carefully can comprehend at once an infinite condition? Can a small child understand in the least degree what the distance from our sun to Alpha Centauri really means? And, similarly, how can we—merely older children—understand the problem of infinity? The mind of man becomes perplexed and bewildered as he ponders upon whether the Universe is finite or infinite. He decides that it cannot be infinite and must therefore be finite, and a little later he concludes that it cannot be finite and must be infinite. Back and forth, like a pendulum, his mind swings between these two possibilities. But by degrees he becomes more accustomed to the Universe, he begins to comprehend very dimly the stupendous possibilities of all-Creation, and he sees at last what a narrow, terrestrial view he had taken at first of illimitable space.

Boundless, illimitable—yes—the infinite Universe! Not to be compared with the atom, with the earth, the sun, or even the vastness of the Milky Way. Not a restricted Universe—however titanic—but one that is worthy of its Creator. A Creation where the aerolite or the vast sun is alike utterly insignificant, where our own Solar System is situated as though in a Universe by itself. Endless, infinite, eternal! Upon our tiny planet the clock ticks on and on; but terrestrial time will cease when man is dead. Amid the illimitable Universe there is no time; but the ages of eternity will pass as sun after sun is extinguished, and solar system after solar system moves about in utter darkness. Things finite will wax and wane; but the infinite will remain unchanged. The internal fires of our world will all die out, some terrible collision may shatter it asunder; but the illimitable Universe will not know that the earth is destroyed. For the Universe is illimitable, without bounds, just as the Universe is eternal, without time.

Boston, Mass.
Hotel Nottingham.

ECLIPSES.

MARIAN McFADDEN and IRENE WINGARD.

Have we no fear, even in this age of advanced learning, when there is an eclipse and the earth becomes dark? Thus it is possible for us to imagine what the feelings of those people in ancient time must have been, when there was an eclipse, or rather as they called it, a fainting of the sun. There are several myths which, to them, accounted for the eclipses. Some believed it to be caused by the sun being devoured by a gigantic monster as a penatly for insufficient offering. The people all over India believed that during the eclipse of the sun and moon a certain dragon with black claws desired to seize the two bodies. During the time of an eclipse, human heads could be seen all over the surface of rivers, for the Indians thought that by immersing themselves up to their necks they would be able to induce the sun and moon to defend themselves against the dragon. There is also a Mongolian myth, which tells how the gods became angry with Arakho for some misdeed and determined to punish him. But he was too quick for them, fled away, and hid. The gods asked the sun where he was but the sun would not tell his hiding place, but the moon told. Therefore they found Arakho, dragged him out and punished him and for this he in revenge pursues the sun and moon. Thus an eclipse occurs when he approaches close to them, and to help the sun and moon a great noise is made and Arakho is finally frightened away. Thus from these myths one can see that the people looked upon eclipses with wonder somewhat akin to worship.

What causes the occurrence of so wonderful phenomena of nature as eclipses? An eclipse of the moon is caused by moon passing into earth's shadow and one of sun caused by moon passing between sun and earth and cutting off the light from a part of the earth. The moon travels around the earth, the earth travels around the sun. The moon's path is inclined to the earth's path 5° and intersects it at two opposite points, and for the lack of a better name we call these points nodes. It takes the moon one month to go around the earth and it takes the earth one year to go around the sun. But because we are unconscious of our motion it appears that the sun is doing the moving and the sun appears to move about 1° in a day while in reality the earth moves 1°. As the moon's path is either below or above the earth's path, it is only at or near the crossing of the paths that the centers of

the sun, moon and earth are in a straight line. Therefore it is at this time or very near it that we have an eclipse of the moon, when the moon is full, and of the sun, when the moon is new.

As a matter of fact astronomers tell us we can have an eclipse of the moon and also of the sun a few degrees either side of the exact crossing. An eclipse of the moon may occur when the moon is within eleven days of the crossing and one of the sun within seventeen days of the crossing. On this account we may have two eclipses of the sun and between these two of the sun we may have one of the moon at each node. As the eclipse of the sun is caused by the new moon coming between us and the sun and a full moon comes half way between two new moons, the full moon would pass into the earth's shadow and be eclipsed. Thus this same order may occur at the opposite node giving us six eclipses during a year; four of the sun and two of the moon. Two eclipses are the least number possible during a year, both of the sun. The reason is this; one eclipse of the sun must occur at each node because the sun will be eclipsed anywhere within seventeen days of the node. It is only fifteen days from full moon to new moon; if the moon is full just outside the seventeen day limit, say eighteen days before the node, the new moon which comes fifteen days after will surely catch the sun before it can pass that node because sun moves only one degree a day. This same thing will occur at the other node, therefore eclipses of the sun are unavoidable at each node. If new moon occurs within the seventeen day limit there will be an eclipse of the sun. Twenty nine days later the second new moon will also catch the sun before it passes the limit because in 29½ days the sun moves 29°.1 and the limit is 34°.

We may not have any eclipses of moon at either node. The eclipse limit of the moon is 21° and the earth's shadow and the sun move about the same rate, about 1° a day. Now if the moon passes the earth's shadow at one node and misses being eclipsed it may miss it at the other node. We may have one eclipse of the moon during the year; when the moon is eclipsed some distance from the node there may be no eclipse at the other node, thus giving us only one eclipse of the moon during a year. Sometimes we have two eclipses of the moon. It is 182.6 days from one node to the other and from one full moon to the next is 29.53 days. Therefore if we have an eclipse of moon exactly at one node and as it is 29.53 days from one full moon to the next, the nearest full moon to this second node will be at the end of 177.18 days. This would cause an eclipse of moon at this node. The nodes are not stationary and the fact that they move slowly further complicates the time and place of an eclipse. In spite of this fact if there is a central eclipse of moon at one node

PLATE XXI

PHOTOGRAPH OF THE ORION NEBULA, SHOWING LOCATION OF POINTS WHERE MEASURES OF RADIAL VELOCITY WERE OBTAINED

there will be one near the other. In an extreme case we may have three eclipses of the moon in one year. If the first eclipse of the moon occurred exactly on the first of January it might be possible to get another eclipse of moon at the same node the last of December, and this would give us seven eclipses in all during the year. Seven eclipses is the greatest number possible during one year; four of sun and three of moon.

Occultations of stars and planets by the moon are nothing but eclipses on a small scale. The stars are hidden for a short time by the moon in its monthly journey around the earth. These occultations are most noticeable when the moon passes over large and bright stars and planets such as Pleiades, Regulus, Pollux or the planet Jupiter.

Formerly astronomers seldom left their homes to observe eclipses, but now some of the governments of the world send out well equipped parties of astronomers for this purpose. An eclipse of the sun is useful for determining more accurately dates of important ancient events, also for searching for a planet which may be between Mercury and the sun, and for studying the sun's upper atmosphere and coronal envelope, which aids in our knowledge of the constitution of the sun. Lunar eclipses are useful for determining the exact length of the month, for testing the temperature of the moon, for finding exact position by its occultation of stars at the time and for a search for a possible tiny little satellite of the moon itself.

NEW CONCEPTIONS OF THE NEBULA OF ORION.

EDWIN B. FROST and CHARLES A. MANEY.

In the *Astrophysical Journal* for October, 1914, Messrs. Buisson, Fabry and Bourget published the remarkable results of their study of the Orion nebula with the use of the interferometer method of M. Fabry. Interference fringes are produced with the light of the nebula by parallel silvered planes, the images of the nebula having been formed at the focus of the 80 cm Foucault reflector of 4.5 meters focus at the observatory of Marseilles. From measurements of the rings, the French savants determine the radial velocity of the nebula at many different points; they also are able to measure with high accuracy the wave-lengths of certain of the spectral lines of nebulium; and they further reach inferences as to the atomic weight of nebulium and as to the temperatures of the nebula.

PHOTOGRAPH OF THE ORION NEBULA, SHOWING LOCATION OF POINTS WHERE MEASURES OF RADIAL VELOCITY WERE OBTAINED

Spectrographic observations of the radial velocity of the nebula have been made by several observers during the past 15 years, but they have generally referred to the small region within the trapezium, and the mean value was about +17 km. From measures on 58 points in 12 directions around the trapezium, but within 2′ from it, the French observers thus obtain a mean radial velocity of +15.8 km per second. Measures now made by the writers on eight plates taken with the Bruce spectrograph of the Yerkes Observatory during the past eleven years yield a result at the position of the western star of the trapezium, known as Bond 619, of +15.6 ±0.5 km, in excellent agreement with that of the French observers.

The surprising result obtained by the interference method, however, is that there are very appreciable motions within the nebula itself: deformation of the rings at certain quite closely adjacent points indicated differences as great as 10 km per second; great collective movements were also revealed, the northeastern region receding, and the southwestern approaching, relatively to the mean velocity at the trapezium, with velocities of about 5 km per second. In other words, we may no longer regard the nebula as an enormous mass of inert gas, but must consider it as writhing and seething in irregular contortions with velocities greater than the molecular velocity of mean square for hydrogen at standard temperature and pressure.

Although there could be no question as to the extreme precision of the interference method in the hands of the eminent French physicists, it seemed desirable to apply the usual spectrographic procedure to the problem. Accordingly observations were begun toward the end of the winter with the Bruce spectrograph arranged for one prism. At most points of the nebula except the trapezium the brightness is not great, and comparatively long exposures are required. Furthermore it was only possible to utilize a few lines of the nebular spectrum for determining the velocity, at most the lines λ5007, Hβ, Hγ and λ4959, and Hδ. The precision of the results may be inferred from the measured velocity of the nebula at the star Bond 619, referred to above. A probable error of ±1.5 km. would be inferred for the mean of measures by the two observers of a single plate. The accordance of the two measures is usually within this limit; but if we call it 2 km., we still find a range of velocity with the spectrograph that seems too much in excess of the presumable error (probable plus systematic) to be unreal. To avoid confusion on the photograph (Plate XXI), the velocities measured have been combined into four values at the points indicated by dots, and the position of the trapezium is indicated by four short straight lines.

These results are regarded only as preliminary, and further plates will be secured when Orion is again available for observation; but these

seem sufficient to be regarded as a confirmation of the results obtained with the interferometer at Marseilles.

Incidental mention may be made of the unexpectedly high temperature of the nebula inferred by the French scientists, viz., 15,000° Abs., a value even higher than the best determinations of the effective temperature of the stars of class B (helium type). One can imagine the delectation with which such a result would be received by the shade of Laplace; but it is so contrary to the generally accepted modern view that the light of the nebulae is not associated with high temperature, that we shall await its further confirmation.

RADIAL VELOCITIES OBSERVED AT VARIOUS POINTS IN THE ORION NEBULA

No.	Date 1915	Exp. (minutes)	ρ F km	No. Lines	ρ M km	No. Lines	Mean ρ km	Position	Taken by
IB 3995	Jan. 29	180	+ 5.4	3	+ 9.5	4	+ 7.4	70″ SE from θ_1	M
4010	Feb. 16	116	+16.2	4	+15.4	4	+15.8	At Bond 624	F
4023	Mar. 1	180	+ 7.7	5	+ 4.4	5	+ 6.0	About 32″ SW of θ_1	B
4025	Mar. 2	108	+20.8	5	+18.5	5	+19.6	Near θ_1	F
4037	Mar. 9	182	+16.5	4	+16.8	4	+16.6	NE of θ_1	M.F.
4044	Mar. 12	189	+13.2	3	+15.4	3	+14.3	27″ W of θ_2	M.F.
4050	Mar. 16	170	+11.7	3	+10.8	4	+11.2	About 70″ SE from θ_1	M.F.

B = Barrett; F = Frost; M = Maney. The tenths of kilometers are not regarded as having any significance.

Yerkes Observatory.
July 9, 1915.

THE OBJECTIVE PRISM*

EDWARD C. PICKERING.

Three methods may be employed for studying the spectra of the stars. First, the slit spectroscope. This is the method most widely used. The light of the star is concentrated on the slit of the spectroscope, and the linear spectrum widened, if necessary, by a cylindrical lens, or by moving the image of the star. Secondly, by the diffraction grating. As in the first method, the image of the star is concentrated on the slit. But little use has been made of this, and other diffraction methods in studying stellar spectra, owing to the great loss of light. Third, the objective prism. A prism of small angle is placed over the objective of the telescope, and the image of every star in the field is thus spread

* Reprinted from Proceedings American Philosophical Society, Vol. li., 1912. Read April 20, 1912.

out into a linear spectrum. Any desired width may be given by allowing the star to traverse the plate slowly, parallel to the edges of the prism. This method cannot well be applied to reflectors, or to other telescopes of large size, owing to the size of prism required. Another objection, in the case of reflectors, is that the prism must be placed so far from the mirror that the definition is injured. These difficulties may be remedied by the focal plane spectroscope, in which the cone of rays from the star is rendered parallel by a concave lens, then passed through a mirror, and brought to a focus by a convex lens. All the light falling on a large mirror may thus be concentrated into a small space, so that the spectrum of a very faint star may be photographed. But little use has been made of this method, although it appears to have great possibilities.

The principal advantages of the objective prism are the small loss of light, and the large number of stars which may be photographed simultaneously. Also, that it is not necessary to follow, as when photographing star charts. The best authorities claim that of the entire light entering the telescope less than one per cent reaches the photographic plate, when a slit spectroscope is used. The proportion of light transmitted by the objective prism must be at least 50 times as great. In fact, the principal loss of light is from the absorption of the objective. Consequently, far fainter stars can be photographed with an objective prism than with a slit spectroscope, the difference amounting to several magnitudes. Another great advantage of the objective prism is that the spectra of all the stars in the field of the telescope can be photographed simultaneously, while with a slit spectroscope only one star can be taken at a time. With the Harvard 8-inch doublet as many as three or four hundred spectra are often photographed on a plate including all stars of the ninth magnitude and brighter, in a region ten degrees square.

A comparison spectrum cannot be used with an objective prism, and it is accordingly difficult to obtain absolute wave-lengths, which are needed to determine the motion of stars in the line of sight. This constitutes the principal objection to the objective prism. Various plans have been proposed to remedy this difficulty, and how far they are successful will be described by another speaker. This does not affect the ordinary measures of wave-lengths, as hydrogen lines are present in the spectra of nearly all the stars, and since these lines are affected by the motion, other lines can be referred to them.

The first photograph of the lines in the spectra of the stars was taken by Dr. Henry Draper of New York. In 1886, Mrs. Draper established, at the Harvard College Observatory, the Henry Draper Memorial, to prosecute the study of stellar spectra. The objective prism has been

used almost exclusively in this work. Two photographic doublets of eight inches aperture have been mounted, one at Cambridge, the other at Arequipa, Peru. With these the entire sky has been covered many times. On one plate more than a thousand spectra were classified. The late Williamina P. Fleming, Curator of astronomical photographs, from an examination of these plates, discovered several thousand objects having peculiar spectra. In fact, probably few bright objects of this class escaped her. Of the nineteen new stars, known to have appeared during the progress of this work, she discovered ten, and five more were found by other observers here. In this work also, the number of stars of the peculiar class known as fifth type, has been increased from seventeen to one hundred and eight.

For a more detailed study of the bright stars, prisms have been attached to the 11-inch Draper Telescope at Cambridge, and to the 13-inch Boyden Telescope at Arequipa. Spectra of the brightest stars have thus been obtained, six inches long, and half an inch wide, showing at least five hundred lines. Prisms twenty-four inches in diameter have been used with the Bruce Telescope in Arequipa, and sixteen inches in diameter with the Metcalf Telescope in Cambridge. The latest and largest investigation undertaken here, as part of the Henry Draper Memorial, is a catalogue giving the class of spectrum of a hundred thousand stars of the eighth magnitude and brighter, shown on the photographs taken with the 8-inch doublets. The classification of spectra used in the Draper Memorial, has been accepted by the superintendents of the principal nautical almanacs in their standard catalogue of three thousand stars, and also at the leading observatories. The preparation of the catalogue mentioned above has been undertaken by Mrs. Fleming's successor, Miss Annie J. Cannon, who has devoted a large part of her time during the last fifteen years to the detailed study of stellar spectra. Her classification of one thousand stellar spectra, published in Volume 28 of the *Harvard Observatory Annals*, occupied her for three years. To complete, in a reasonable time, a catalogue of one hundred thousand spectra evidently required the most careful study of the methods of "scientific management." As a first step, her contribution to the work, which required the greatest skill, was reduced from one hundred to six per cent, the remainder being performed as a great piece of routine work, by less experienced assistants. The utmost care has been taken to maintain the highest degree of accuracy, the probable error of the result for each star being about a tenth of one interval, corresponding to four one-hundredths of a stellar magnitude. Miss Cannon is now classifying five thousand spectra a month, and has already classified twenty-seven thousand spectra. The completed catalogue will fill four of the quarto volumes

of the *Annals* of the observatory, of about two hundred and fifty pages each, and will give the class of spectrum of nearly all of the stars of the eighth magnitude and brighter, besides many others. Some of these are so faint that they are not contained in the *Cape Photographic Durchmusterung*.

Dr. Draper thus placed in our hands a wonderful tool for analyzing the stellar universe. His memorial furnishes not only a permanent record in print of great extent, but, through the collection of photographs, will permit in the future a vastly greater number of facts to be derived from them.

VIEW OF SATURN IN A SIXTEEN-INCH REFLECTOR.*

R. BURNSIDE POTTER.
Member of the Society for Practical Astronomy.

It is with some diffidence that I come, as an artist, before a body of astronomers, even if the majority are not professionals. My own knowledge of astronomy is limited, and I have so few opportunities for observation and study that I can hardly call myself even an amateur, except in the sense that this word means *lover* of astronomy.

However, the painting of Saturn which is on exhibition here today,† and which is the subject of this brief paper, was made for a special purpose, and I hope to forestall criticism by saying that it has no pretense to great scientific accuracy. (I could not tell you for instance by how much the southern part of the ball overlaps the Cassini division). It is intended to give a painter's impression of what an ordinary observer may see in an instrument of moderate size. This instrument was a sixteen-inch Newtonian reflector by Mr. Mellish, and if I am not mistaken is the same one with which he discovered the Mellish comet. The mirrors were in perfect condition, and, except for the usual slight haze on the horizon, observing conditions were as good as they ever are at my station. The view represents the planet as seen with a magnification of 580 diameters. As a matter of fact, more detail was seen with lower powers, but I used this eyepiece to make the drawing

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* Read before the Second Annual Conference of the Society for Practical Astronomy, held at the University of Chicago, Chicago, Ill., 1915 August 16, 17, and 18. Communicated by the President of the Society.

† Reproduced as Plate XIX, Vol. XXIII of POPULAR ASTRONOMY. (May, 1915), opposite p. 257.

because it made the objects appear larger in proportion to the size of the field than a lower one would have done, whereas a higher power would not have permitted me to get in all the satellites. The painting will appear in correct size if looked at from a distance of forty inches. The reproduction which appeared in POPULAR ASTRONOMY should be held at eighteen inches from the eye. This reproduction, while very successful as far as the planet itself is concerned, of course, makes the sky appear very much too light, owing to a three-color process having been used. It gives a good idea, however, of how the planet looks in twilight, although I doubt if Enceladus would be visible. The colors I used, besides black and white, were rose madder, aureolin yellow and cobalt blue, and the painting was made from very careful notes and sketches at the telescope, and from a sketch in oils, half the size, worked up the next morning as soon as it was daylight.

This is the first time to my knowledge that oil color has been used to attempt exactly this sort of thing, and I do not pretend that the medium is extremely appropriate. It is a very difficult matter and requires a very steady hand to draw ellipses at this scale with a brush charged with pigment, and I do not think that I have succeeded very well. What I wanted to show, however, was the glare which appears around all bright objects in a reflector of that size and to bring out the color of the planet and satellites, and all I can say is that my efforts in this respect were conscientious. Professor Herbert C. Wilson, editor of POPULAR ASTRONOMY, thinks that I have made the equatorial regions too dark, and in the light of subsequent observation, I am inclined to agree with him, but all my notes during that apparition of Saturn say that the white line between the two pink belts was much the brightest portion of the whole. I am somewhat mortified that at this opposition I did not note the blue polar cap which I have frequently seen since with smaller apertures.

The date of observation was October 21st, 1912, 2 A. M. Eastern Standard Time. The dimensions of the ball and rings were taken from Young's *General Astronomy*. The positions of the satellites were noted by aliniation with cross wires in the telescope and checked up the following day from the *Nautical Almanac* by laying off their orbits on a drawing board. The positions corresponded very closely, Enceladus in fact being pricked right through, but Iapetus was about one inch out of the way, and if I had used the position given in the almanac it would have fallen outside the frame. I had to put the principal object out of center anyway in order to get in all the satellites, but I do not consider this a drawback, as realism was aimed at, and an object is hardly ever in the center of an amateur's field of view, at least not in my case. The objects from left to right are: a fixed star, Titan, Iapetus,

Enceladus, Tethys, Dione and Rhea. The star was a little brighter than Titan, but I could not identify it, as my charts gave nothing fainter than magnitude six and a half. The disc of Titan is supposed to be at scale, but my impression is that I took the largest value for his diameter that I could find in the various text books I looked over so as to make him look as well as possible. The others, of course, are relative. Mimas was entirely invisible, lost in the glare of the planet, but there was a faint point of light glimpsed in the position that Hyperion should have occupied. I do not claim to have seen it on this occasion, however, and, of course, it would be impossible to reproduce the impression in the picture.

I do not think that I can add much else, except to say that there was no trace of the Encke division, although I have since seen it very distinctly with the same instrument, but I have never succeeded in seeing the northern part of the ball of the planet through the Cassini opening.

My own criticism of the picture as a whole is that whereas the colors are *relatively* right, the whole planet is a little too *yellow* as contrasted with the blue of the sky.

I trust that I have not taken up too much time with what is really a sort of side show, and I shall be glad to answer any questions during the Conference, provided I am able to do so.

Antietam Farm, Smithtown, N. Y.

EIGHTEENTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

The eighteenth meeting of the American Astronomical Society was held from August 2 to 7, 1915, in connection with the Pacific Coast meeting of the American Association for the Advancement of Science. Five sessions of the Society were held for the reading of papers and transaction of business, and these were distributed between the Students' Observatory at Berkeley, Stanford University, and the Lick Observatory. Vice-President Schlesinger presided at the meetings.

Dr. W. W. Campbell, Director of the Lick Observatory and long an officer in this Society, had been elected President of the American Association, and many of the members attended the opening meeting of the Association, in the Scottish Rite Auditorium San Francisco, and heard his address on "Science and Civilization." The same evening there was a general reception to the visiting men of science in the California Building of the Panama Pacific International Exposition.

On Tuesday morning, August 3, there was a joint meeting of the American Astronomical Society, the American Mathematical Society, the American Physical Society, and Sections *A* and *B* of the American Association, with Vice-President Leuschner of Section *A* presiding. Two interesting and important addresses were given:

"The Human Significance of Mathematics" by Professor C. J. Keyser of Columbia University, and

"The Work of a Modern Observatory" by Professor George E. Hale of Mt. Wilson Solar Observatory.

Professor Hale's lecture was illustrated by several experiments giving laboratory imitations of various solar phenomena.

Following the joint session, the visiting astronomers, mathematicians, and physicists were entertained at luncheon at the Faculty Club, Berkeley, by Professors Leuschner, Haskell, and Lewis.

In the afternoon the Society assembled at the Students' Observatory for a joint meeting with the Astronomical Society of the Pacific, and this session was the occasion for the presentation of the Bruce Medal of the Astronomical Society of the Pacific to Dr. W. W. Campbell, the address of award being delivered by Professor R. T. Crawford.

On Wednesday, August 4, the members took part in the excursion of the American Association and affiliated societies to Stanford University. The visitors were met at Palo Alto and taken in automobiles through the beautiful campus and surroundings; later they gathered in the assembly hall, where they were welcomed by Chancellor Jordan. After a response by Dr. Campbell the meeting adjourned for lunch, which was served in one of the courts of the quadrangle. The afternoon was taken up with scientific sessions of the different sections and societies.

On returning to San Francisco in the evening, the astronomers took the ferry to Oakland, where they had a joint dinner with the American Mathematical Society at the Hotel Oakland.

On Thursday the time was largely taken by two sessions for papers, but adjournment was had in time for the tea which was given for the visiting men of science on the lawn of the Faculty Club, Berkeley, by the ladies of the faculties of the Universities, California and Stanford.

On Friday, August 6, some forty-five members of the astronomical and mathematical societies took trains from San Francisco or Oakland and assembled at San Jose about 11 A. M. Members of the Lick Observatory staff had already returned to the mountain to make ready for their expected guests, leaving Professor Tucker to guide the visitors. Under his supervision the eight automobiles left San Jose and followed the road up Mt. Hamilton. At Smith Creek there was a stop of an hour for lunch, and by three o'clock the last car had reached the summit without accident. The visitors were welcomed by Director and

Mrs. Campbell and others of the staff, and then separated into parties and were shown the different buildings and instruments.

At four o'clock the Society met in the observatory library for a short business meeting which had been announced for this day. After this the members and friends walked or rode to the picnic grounds, about a mile away on the side of Mt. Copernicus, where the families of the observatory staff had prepared a supper. Some sixty persons sat at one long table, and were waited on by the younger members of the community. After supper the visitors found their way back to the observatory by various routes, in order to view the sunset which Director Campbell announced had been predicted for that evening.

The sky was perfectly clear, and as it grew dark the guests repaired to the different telescopes where they had opportunity to view objects under California conditions. The great 36-inch refractor was naturally the center of interest, and the special object shown here was the Hercules cluster.

Some of the more timorous, being anxious to be through with the night ride down the mountain, were ready to start quite early by astronomical reckoning, and at ten o'clock the visitors had left the observatory, and by midnight they were all safe in their respective hotels in San Jose.

The event of the next day, Saturday, August 7, came as a fitting climax to the meeting. Mrs. Phoebe A. Hearst had invited the members of the astronomical and mathematical societies to her country place, Hacienda del Pozo de Verona, near Pleasanton. The numbers of those going by train from San Jose were swelled by additions from Berkeley and Oakland. On arrival at Pleasanton, the guests were taken by automobile through the beautiful drive leading to the Hacienda, where they were welcomed by Mrs. Hearst. After a most interesting inspection of the art treasures and interior of the house, they strolled about the gardens and then returned for luncheon. The day was given over wholly to social intercourse, and the members were loath to depart, leaving for San Francisco on the special train which Mrs. Hearst had generously provided.

This, the first California meeting of the Society, was marked not only by a full attendance and program of papers, and by the joint sessions with the American Mathematical Society, the Astronomical Society of the Pacific, and the American Physical Society, but also by the unusual number and extent of the social features and excursions. The activities extended over six full days, not to mention the time taken before or after the meetings for visits to the Panama-Pacific International Exposition. The opportunity to see the Students' Observatory, the Lick Observatory, and the two Universities and meet their staffs made the

occasion unique. Some of the members also took advantage of their being on the coast to visit the Mt. Wilson Solar Observatory and the site of the new Dominion Observatory at Victoria, British Columbia.

The following resolution presented by Dr. Plaskett was adopted by the Society:

"Resolved that the American Astronomical Society desires to express its appreciation of, and hearty thanks for, the courtesies extended and the services given during its recent meeting, by the authorities of the University of California and the Leland Stanford Junior University, It wishes also to express its appreciation of the hospitality extended by the officers of the Students' Observatory and of the Lick Observatory, and by Mrs. Hearst. It requests the Secretary to communicate to these officers and individuals the sincere thanks of the Society for the kindnesses which have added so much to the success and enjoyment of the meeting."

In seconding this resolution Professor Hale not only expressed appreciation of the hospitality of the Lick Observatory, but also drew attention to the great influence which this institution has had on the development of other observatories both in this country and abroad.

One of the main items of business during the meeting was the amendment of Article V of the Constitution of the Society, which had been petitioned in due form. The change was adopted by the unanimous vote of those present, and Article V will henceforth read:

Art. V. Sec. 1. The dues shall be Two Dollars per annum.

Sec. 2. Any member of the Society in good standing may at any time pay into the treasury the sum of Twenty-five Dollars and shall thereafter be exempt from dues. The sums thus paid into the treasury shall be deposited or invested as a permanent fund. The interest accruing from this fund, together with the annual payments of dues, shall be disbursed as the Council may direct to meet the necessary expenses of the Society.

Sec. 3. No officer of the Society shall receive any compensation for services rendered to it, but the Council may by resolution direct the Treasurer to reimburse to any officer expenses necessarily incurred by him in the discharge of his official duty.

At the afternoon session of August 5, Mr. H. K. Bassett, Assistant Director of Congresses of the Panama-Pacific International Exposition, was present on behalf of the Exposition authorities to welcome the Society to California, and to present to the society a bronze plaque in commemoration of the meeting of 1915. Dr. Schlesinger in appropriate remarks acknowledged the courtesy of the exposition officials.

A report from President Pickering stated that no action had been taken by Congress in regard to the appropriation for the International Geodetic Association, and the Society voted to reaffirm its previous resolution in favor of this country's continued support of that work.

In the discussion following Professor Townley's paper, and on his motion, the Society voted that a committee of three or five be appointed by the President to consider the question of variable star nomenclature.

The Council, acting on a resolution presented by Professor Fox, authorized the appointment of a further committee to consider the adoption of standard star epochs to replace the multiplicity of epochs now used in giving star positions.

The selection of place and date of the next meeting was left for action of the Executive Committee.

The Council elected new members as follows:

Dinsmore Alter, Students' Observatory, Berkeley, Cal.
Miss Mary Fowler, Princeton University Observatory, Princeton, N. J.
W. K. Green, Lick Observatory, Mt. Hamilton, Cal.
George F. Paddock, Lick Observatory, Mt. Hamilton, Cal.
Miss Florence J. Stocker, Allegheny Observatory, Pittsburgh, Pa.
O. H. Truman, State University of Iowa, Iowa City, Ia.
F. C. Weaver, Bureau of Standards, Washington, D. C.
Miguel Selga, Manila Observatory, Manila, P. I.

On petition in due form,

Professor Jacobus Cornelius Kapteyn, Director of the Astronomical Laboratory at Groningen, Holland,

was unanimously elected to Honorary Membership.

On August 6, officers of the Society were elected for the ensuing year:

President	Edward C. Pickering
First Vice-President	W. W. Campbell
Second Vice-President	Frank Schlesinger
Secretary	Philip Fox
Treasurer	Annie J. Cannon
Councillors 1915-17	Edwin B. Frost
	Joel Stebbins

Officers continuing to serve unexpired terms are

Councillors 1914-16	W. S. Eichelberger
	J. S. Plaskett

Professor Joel Stebbins was appointed editor for the meeting.

The following members of the Society were present at the Pacific Coast meeting:

C. G. Abbot
C. E. Adams
R. G. Aitken
Dinsmore Alter
A. T. G. Apple
L. A. Bauer
F. P. Brackett
R. T. Crawford
H. D. Curtis
W. W. Campbell
C. L. Doolittle
A. E. Douglass
W. S. Eichelberger
Sturla Einarsson
E. A. Fath
Caroline E. Furness
George E. Hale
W. M. Hamilton
Margaret Harwood
Otto Klotz
Eleanor A. Lamson
E. L. Larkin
O. J. Lee
A. O. Leuschner
W. F. Meyer
S. A. Mitchell
J. H. Moore
R. M. Motherwell
S. B. Nicholson
G. F. Paddock
J. S. Plaskett
W. F. Rigge
Frank Schlesinger
F. H. Seares
Miguel Selga
Harlow Shapley
Joel Stebbins
Helen M. Swartz
G. D. Swezey
S. D. Townley
O. H. Truman
R. H. Tucker
A. B. Turner
Louise W. Ware
W. H. Wright

BRIGHT LINES IN CLASS B AND CLASS M SPECTRA.

BERNHARD H. DAWSON.

Bright lines are found in the spectra of five classes of objects; gaseous nebulae, novae, Wolf-Rayet stars, some stars with Class B spectra and long period variables. In the first three we have either no continuous spectrum or a very weak one with comparatively little absorption. In the last two, however, we have cases of bright lines superposed on a well marked absorption spectrum.

Among the B type stars, γ Cassiopeæ and β Lyræ were announced by Secchi in 1867 to have spectra showing bright lines, but in the former case the presence of absorption lines was long in question, and even in 1894 Scheiner doubted their presence. Improved instrumental means, however, has made it possible not only to confirm the existence of dark lines, but also to show the bright lines to be double and even triple reversals. This is also true in the case of other stars of the type. β Lyræ shows a very peculiar spectrum, not only in having a blend of types, but also in its variable character. Absorptions both of class B5 and of class B8 are present, together with bright lines, not only of hydrogen but also of helium, magnesium and iron. These phenomena, along with the light variation and the variation of radial velocity, are explicable by the hypothesis of two bodies, one with a relatively small photosphere giving a faint continuous spectrum and a large atmosphere

giving one set of absorption lines and the bright lines, the other a large body of relatively small mass giving most of the continuous spectrum and the other set of absorption lines.

In the spectrographic surveys carried on by Harvard, there have been discovered upwards of sixty stars with bright Hβ. In many cases the presence of Hα has been determined by other observers, but the plates of the survey are not sensitive to such long waves. It can nevertheless be assumed that Hα is bright wherever Hβ has been observed, for it is an invariable rule that the bright lines are those of greatest wave-length. In Vol. 56 of the *Harvard Annals* there is a list of stars having bright hydrogen lines. Of these there are eighty-seven that are of B and successive types to A inclusive. The number is too small to show anything of the type preference of the group, though B3 may perhaps be the center. The distribution in the other direction is, however, clear, for we find four stars in which the bright line series is complete up to Hζ or further, three in which it stops with Hϵ, twenty that have the lines to Hδ, seventeen that have the first three members only, while in forty-two the series is reduced to two. In thirty-three of these last only Hβ has actually been observed. Summing up all that have each successive line bright, we have 4, 7, 27, 44 and 86. The eighty-seventh star is Alcyone, which has only the Hα bright, and thus forms a link between these bright line stars and the ordinary helium stars.

The fact that the brightened lines are the lines of greater wave length and that in the majority of cases they are limited to two or three is significant, for it indicates low temperature in the gas emitting these radiations. The hypothesis following from that is that these bright line stars are stars in which an extraordinarily large atmosphere of hydrogen has developed. This atmosphere is of course cooler than the interior of the star, and absorbs the regular series of wave lengths from the light of the photosphere, but on the other hand it is of very great extent and its own weaker radiations of the longer waves come consequently from such an immense area that they serve to re-reverse the first few lines of the series. The light from this atmosphere should again suffer a reversal in passing through its upper strata, and this third reversal is in fact often observed.

It seems probable that these stars do not form part of the regular line of stellar evolution, but rather that they have developed these characteristics through individual peculiarities.

In the long period variables we have a radically different state of affiairs. The background is a fluted spectrum in which hydrogen absorption, if present at all, is insignificant in comparison with the heavy metallic and titanium oxide absorption. Superposed on this spectrum we have, at and near the star's maximum brightness, a series of bright

hydrogen lines, but often this series begins with some other lines than $H\alpha$. This phenomenon was first announced by Pickering in 1887, when he reported that the spectrum of Mira had a series of bright hydrogen lines from $H\delta$ on out to $H\iota$, with $H\epsilon$ omitted. This series has since been extended to include $H\gamma$, but the two longer waves are lacking. These bright lines were then stated to be present in other stars, also long period variables, and since that time many long period variables previously known have had the same phenomena detected in their spectra, and the connection has even been used in the other sense, for many long period variables have been discovered by means of the characteristics of their spectra on the plates of the Harvard survey. Not all long period variables have these bright lines, but the converse seems to be true, for a star with this class of spectrum is almost if not quite without exception variable in a long period, and there can be no doubt that variability and this spectral type are physically connected.

The arrangement of the bright lines in these stars has no such regularity as in the helium stars, for here the series often begins with $H\gamma$ or $H\delta$ and runs far out into the ultra-violet, while stars are also found with $H\beta$ and $H\gamma$ bright and $H\delta$ scarcely visible. The designation for all in the Draper classification is Md, this being split into ten or eleven subdivisions, the criteria being the relative intensity of the several members of the bright line series. The first of these subdivisions has $H\beta$ and $H\gamma$ bright with $H\delta$ weak or invisible, the last has $H\beta$ invisible, $H\gamma$ barely seen, and $H\delta$ strong. $H\epsilon$ is never seen brightened in these stars, for it coincides with the heavy absorption of the H line of calcium and is either blotted out or fails to appear for want of background. While these spectra are thus classified into smoothly merging grades, there is nevertheless no supposition of an evolutional relation of either succession or parallelism.

In the list of long period variables in Vol. 56 of the *Harvard Annals*, out of 459 stars whose spectral classifications are given, 393 or nearly 86% are of class Md. Of these about one-third are simply given as Md, the others are subdivided, falling mostly between Md4 and Md8, with the maximum number at Md6 and a strong falling off in each direction. I would consider this selective tendency as evidence that the subdivisions are parallel developments, rather than successive. Whether that be so or not, the fact that over 85% of the long period variables have this class of spectrum is sufficient evidence that it is not mere coincidence.

The fact that the spectra of sunspots have points of similarity with these, taken together with the facts that $H\epsilon$ is never seen brightened and that the general type of light curve is shaped much like the curve of sunspot activity, would indicate that the bright lines in these spectra

arise from eruptive action in the star at the base of a dense atmosphere. A detailed study of the relations and changes of the spectrum has been made in but few cases. Mira itself is about the only one that has been exhaustively studied. What has been done with the others has borne out the conclusions deduced from the study of Mira, namely, that the bright lines are not only absolutely but also proportionately stronger at and near the epoch of maximum, fading and perhaps even disappearing at minimum.

The action, then, would seem to be somewhat geyser-like, the bringing of heated material to the radiating surface being to a certain extent intermittent. The cycle would consist of a period of comparative inactivity in which the temperature of the interior gradually rises through contraction, then a bursting forth of the heated vapors through the cooler and perhaps viscous surface; the interchange of heated material from within for cooler material from without would then lower the temperature of the interior so that the action would gradually diminish, finally dying down enough to allow some of the breaks in the outer layer to seal over, starting the interior on another period of rising temperature. An action of this sort would complete a cycle in an approximately regular period, but there would be minor variations of the interval which would apparently come fortuitously, and such is indeed the case with many of the long period variables. For many years observers tried to analyze the light curve of Mira with a view to predicting maxima, but while the average period has remained substantially the same, all attempts to predict maxima closer than ten or twenty days have failed.

In these two classes of spectra containing bright hydrogen lines, we have the single likeness of the superposition of the lines on an absorption spectrum. In other respects they are radically different. In the early stars it is invariably the lines of greatest wave length that are brightened, and in general there are but few of them, indicating comparatively low temperature in the radiating layer; in the variables the series often begins with the third or fourth term and runs far into the ultra-violet, indicating that the lines come from the hottest part of the star. In the early stars triple reversals indicate that the light comes from an immensely extensive atmosphere; in the variables the lines shine out independently, but the absence of H_ϵ would indicate that a heavily absorptive layer of calcium vapor was present, probably above the radiating hydrogen. The early stars are seldom if ever variable unless they be binary, while the class Md spectrum is almost certain evidence that the star will be found variable.

Ann Arbor, Mich., 1915 June 11.

PLANET NOTES FOR NOVEMBER, 1915.

The sun will move from 14° 10′ south to 21° 31′ south during this month. It will move eastward from Libra into Scorpio and will be just north of Antares at the end of the month.

THE CONSTELLATIONS AT 9:00 P. M. OCTOBER 1.

The phases of the moon for this month are as follows:

New Moon	Nov. 7	"	2 A.M.	C.S.T.
First Quarter	13	"	5 P.M.	"
Full Moon	21	"	12 M.	"
Last Quarter	29	"	4 P.M.	"

Mercury will be at a point of greatest distance west of the sun on November 7. It will be about eight degrees north of the sun at this date and will therefore rise a few hours before the sun. It will be easily visible in the east just before sunrise on and near this date. It will then move toward the sun on the opposite side of the sun from the earth.

Venus will just begin to become visible in the west after passing the sun. It will be very low in the west at sunset throughout the month. It may be seen but will be too low for study.

Mars will continue to rise earlier and earlier during the month. It will rise about midnight and will be well up in the sky before sunrise. It will be approaching the earth rapidly during this period.

Jupiter will be on the meridian in the early evening during this month. It will be moving eastward slowly. It will easily be recognized because of its great brilliancy.

Saturn will be visible in the early morning. It will be on the meridian about three o'clock in the morning at the middle of the month.

Uranus will be in quadrature with the sun, 90° east, on November 4. It will therefore be well situated for evening observation during this month.

Neptune will be on the meridian a few hours before sunrise. It will therefore be visible only in the early morning.

Phenomena of Jupiter's Satellites.

[Visible at Washington.]
CENTRAL STANDARD TIME.

		h	m					h	m		
Nov.	1	4	58	I	Sh. In.	Nov.	15	8	49	I	Sh. In.
		6	13	I	Tr. Eg.			9	53	I	Tr. Eg.
		7	15	I	Sh. Eg.			11	06	I	Sh. Eg.
		11	39	II	Oc. Dis.		16	4	56	I	Oc. Dis.
	2	4	33	I	Ec. Re.			8	24	I	Ec. Re.
		7	22	III	Oc. Re.			11	39	III	Oc. Dis.
		8	43	III	Ec. Dis.		17	5	34	I	Sh. Eg.
		11	28	III	Ec. Re.			11	38	II	Tr. In.
	3	6	44	II	Tr. In.		19	5	45	II	Oc. Dis.
		8	53	II	Sh. In.			11	04	I	Oc. Re.
		9	34	II	Tr. Eg.		20	4	30	III	Tr. Eg.
		11	42	II	Sh. Eg.			6	38	III	Sh. In.
	5	5	49	II	Ec. Re.			9	31	III	Sh. Eg.
	6	5	27	IV	Sh. In.		21	6	16	II	Sh. Eg.
		7	52	IV	Sh. Eg.		22	9	27	I	Tr. In.
		11	18	I	Tr. In.			10	45	I	Sh. In.
		12	24	I	Sh. In.			11	08	IV	Tr. In.
	7	8	37	I	Oc. Dis.			11	45	I	Tr. Eg.
		12	00	I	Ec. Re.		23	6	48	I	Oc. Dis.
	8	5	45	I	Tr. In.			10	20	I	Ec. Re.
		6	53	I	Sh. In.		24	5	14	I	Sh. In.
		8	2	I	Tr. Eg.			6	13	I	Tr. Eg.
		9	10	I	Sh. Eg.			9	31	I	Sh. Eg.
	9	6	28	I	Ec. Re.		25	4	48	I	Ec. Re.
		7	57	III	Oc. Dis.		26	8	16	II	Oc. Dis.
		11	00	III	Ec. Re.		27	5	14	III	Tr. In.
	10	9	10	II	Tr. In.			8	21	III	Tr. Eg.
		11	31	II	Sh. In.			10	41	III	Sh. In.
		12	00	II	Tr. Eg.		28	6	04	II	Sh. In.
	12	8	26	II	Ec. Re.			6	16	II	Tr. Eg.
	13	5	29	III	Sh. Eg.			8	53	II	Sh. Eg.
	14	10	28	I	Oc. Dis.		30	8	41	I	Oc. Dis.
	15	7	36	I	Tr. In.						

Note:—In., denotes ingress; Eg., egress; Dis., disappearance; Re., reappearance Ec., eclipse; Oc., occultation; Tr., transit of the satellite; Sh., transit of the shadow

Occultations Visible at Washington.

Date 1915	Star's Name	Magnitude	IMMERSION. Washington M.T.	IMMERSION. Angle from N.	EMERSION. Washington M.T.	EMERSION. Angle from N.	Duration
			h m	°	h m	°	h m
Nov. 18	101 Piscium	6.2	8 42	80	10 00	210	1 18
19	26 Arietis	6.2	13 44	88	14 58	240	1 14
24	ϵ Geminorum	3.2	8 28	148	9 00	210	0 32
25	187 B Gemin.	6.3	11 19	51	12 11	328	0 53
27	π Cancri	5.6	10 15	174	10 37	218	0 22

VARIABLE STARS.

Approximate Magnitudes of Variable Stars of Long Period on Sept. 1, 1915.

[Communicated by the Director of Harvard College Observatory, Cambridge, Mass.]

Name.	R. A. 1900.	Decl. 1900.	Magn.	Name.	R.A. 1900	Decl. 1900	Magn.
	h m	° ′			h m	° ′	
X Androm.	0 10.8	+46 27	13.0*d*	R Hydrae	13 24.2	−22 46	7.8*d*
T Androm.	17.2	+26 26	10.4 *i*	T Urs. Min.	32.6	+73 56	9.5 *i*
T Cassiop.	17.8	+55 14	11.6*d*	R Can. Ven.	44.6	+40 2	11.6 *i*
R Androm.	18.8	+38 1	10.4*d*	U Urs. Min.	14 15.1	+67 15	11.0 *i*
Y Cephei	31.3	+79 48	<12.5	S Bootis	19.5	+54 16	8.6
U Cassiop	40.8	+47 43	12.0 *i*	RS Virginis	22.3	+ 5 8	9.5*d*
V Androm.	44.6	+35 6	<13	R Camelop.	25.1	+84 17	8.5
RR Androm	45.9	+33 50	<13	V Bootis	25.7	+39 18	8.8 *i*
W Cassiop.	49.0	+58 1	10.0*d*	R Bootis	32.8	+27 10	12.3
U Androm.	1 9.8	+40 11	13.5	Y Librae	15 6.4	+ 5 38	13.0
S Cassiop.	12.3	+72 5	11.9*d*	S Librae	15.6	−20 2	10.4*d*
S Piscium	12.4	+ 8 24	<13.5	S Serpentis	17.0	+14 40	9.2*d*
U Piscium	17.7	+12 21	12.3*d*	S Cor. Bor.	17.3	+31 44	12.5*d*
RZ Persei	23.6	+50 20	10.9*d*	RS Librae	18.5	−22 33	9.0 *i*
R Piscium.	25.5	+ 2 22	10.6 *i*	RU Librae	27.7	−14 59	11.3*d*
Y Androm.	33.7	+38 50	<13.5	S Urs. Min.	33.4	+78 58	9.2*d*
X Cassiop.	49.8	+58 46	11.5*d*	R Cor.Bor.	44.4	+28 28	7.8 *i*
U Persei	53.0	+54 20	11.0	X Cor. Bor.	45.2	+36 35	13.0*d*
S Arietis	59.3	+12 4	<13	V Cor. Bor.	46.0	+39 52	10.8*d*
R Arietis	2 10.4	+24 35	8.7 *i*	R Serpentis	46.1	+15 26	12.3*d*
o Ceti	14.3	− 3 26	8.9*d*	Z Cor. Bor.	52.2	+29 32	11.8*d*
S Persei	15.7	+58 8	8.8	RZ Scorpii	58.6	−23 50	10.0 *i*
R Trianguli	31.0	+33 50	8.9*d*	R Herculis	16 1.7	+18 38	14.0
W Persei	43.2	+56 34	9.7*d*	U Serpentis	2.5	+10 12	10.8*d*
X Ceti	3 14.3	− 1 26	<13	RU Herculis	6.0	+25 20	12.2*d*
Y Persei	20.9	+43 50	9.2 *i*	W Cor. Bor.	11.8	+38 3	12.3 *i*
R Persei	23.7	+35 20	10.3 *i*	V Ophiuchi	21.2	−12 12	9.5*d*
W Tauri	4 22.2	+15 49	11.0*d*	U Herculis	21.4	+19 7	10.5*d*
R Tauri	22.8	+ 9 56	10.0	SS Herculis	28.0	+ 7 3	10.2*d*
S Tauri	23.7	+ 9 44	<13	W Herculis	31.7	+37 32	9.8*d*
T Camelop.	30.4	+65 57	11.8*d*	R Draconis	32.4	+66 58	7.9*d*
X Camelop.	32.6	+74 56	12.5	RR Ophiuchi	43.2	−19 17	<12
RX Tauri	32.8	+ 8 9	<11	S Herculis	47.4	+15 7	10.9*d*
R Leporis	55.0	−14 57	8.5*d*	RV Herculis	56.8	+31 22	11.7*d*
R Aurigae	5 9.2	+53 28	10.2*d*	R Ophiuchi	17 2.0	−15 58	10.2*d*
W Aurigae	20.1	+36 49	10.0 *i*	RT Herculis	6.8	+27 11	11.1*d*
V Camelop.	49.4	+74 30	<12.5	Z Ophiuchi	14.5	+ 1 37	10.5*d*
X Aurigae	6 4.4	+50 15	11.4*d*	RS Herculis	17.5	+23 1	9.6 *i*
R Urs. Maj.	10 37.6	+69 18	12.8*d*	RU Ophiuchi	28.1	+ 9 30	11.7 *i*
T Urs. Maj.	12 31.8	+60 2	7.9 *i*	RT Ophiuchi	51.8	+11 11	<13
R Virginis	33.4	+ 7 32	7.1	T Draconis	54.8	+58 14	10.3*d*
S Urs. Maj.	39.6	+61 38	10.3*d*	RY Herculis	55.4	+19 29	13.0*d*
RU Virginis	42.2	+ 4 42	10.0 *i*	T Herculis	18 5.3	+31 0	8.2 *i*

Approximate Magnitudes of Variable Stars of Long Period on Sept. 1, 1915—Continued.

Name.	R. A. 1900. h m	Decl. 1900. ° ′	Magn.	Name.	R.A. 1900. h m	Dec. 1900. ° ′	Magn.
W Draconis	18 5.4	+65 56	<12	V Cygni	20 38.1	+47 47	9.7 *i*
W Lyrae	11.5	+36 38	8.9*d*	S Delphini	38.5	+16 44	<12
RY Ophiuchi	11.6	+ 3 40	13.1*d*	T Delphini	40.7	+16 2	8.9 *i*
T Serpentis	23.9	+ 6 14	12.3*d*	V Delphini	43.2	+18 58	<13
RZ Herculis	32.7	+25 58	10.2	T Aquarii	44.7	− 5 31	8.0 *i*
X Ophiuchi	33.6	+ 8 44	7.2 *i*	RZ Cygni	48.5	+46 59	12.0*d*
RW Lyrae	42.1	+43 32	<13.5	X Delphini	50.3	+17 16	8.5 *i*
R Aquilae	19 1.6	+ 8 5	6.7 *i*	R Vulpeculae	59.9	+23 26	10.2*d*
V Lyrae	5.2	+29 30	<13	TW Cygni	21 1.8	+29 0	11.0*d*
RY Sagittarii	10.0	−33 42	6.8	T Cephei	8.2	+68 5	7.8 *i*
R Sagittarii	10.8	−19 29	8.5 *i*	X Pegasi	16.3	+14 2	9.5
U Lyrae	16.6	+37 42	11.0	T Capricorni	16.5	−15 35	11.3*d*
TY Cygni	29.8	+28 6	13.0*d*	S Cephei	36.5	+78 10	11.5*d*
RT Aquilae	33.3	+11 30	10.4*d*	SS Cygni	38.8	+43 8	8.9*d*
R Cygni	34.1	+49 58	11.0*d*	RR Pegasi	40.0	+24 33	9.0 *i*
RV Aquilae	35.9	+ 9 42	9.8 *i*	RT Pegasi	59.8	+34 38	11.2
RT Cygni	40.8	+48 32	10.5 *i*	T Pegasi	22 4.0	+12 3	13.0
TU Cygni	43.3	+48 49	<13	Y Pegasi	6.8	+13 52	<11
X Aquilae	46.5	+ 4 13	12.8*d*	RS Pegasi	7.4	+14 4	<11
χ Cygni	46.7	+32 40	12.8*d*	S Lacertae	24.6	+39 48	10.5*d*
Z Cygni	58.6	+49 46	13.0	S Aquarii	51.8	−20 53	<12.5
SY Aquilae	20 2.3	+12 39	12.5*d*	RW Pegasi	59.2	+14 46	9.0 *i*
S Cygni	3.4	+57 42	<13.5	R Pegasi	23 1.6	+10 0	12.4*d*
S Aquilae	7.0	+15 19	11.2*d*	V Cassiop.	7.4	+59 8	8.8 *i*
RU Aquilae	8.0	+12 42	11.6 *i*	W Pegasi	14.8	+25 44	9.8*d*
RS Cygni	9.8	+38 28	9.3*d*	S Pegasi	15.5	+ 8 22	9.4*d*
Z Aquilae	9.8	− 6 27	11.4*d*	ST Androm.	33.8	+35 13	9.6*d*
R Delphini	10.1	+ 8 47	11.0*d*	R Aquarii	38,6	−15 50	6.5 *i*
SX Cygni	11.6	+30 46	10.8*d*	Z Cassiop.	39.7	+56 2	13.6*d*
U Cygni	16.5	+47 35	7.8 *i*	R Cassiop.	53.3	+50 50	10.6 *i*
Z Delphini	28.1	+17 7	9.2*d*	Z Pegasi	55.0	+25 21	13.8*d*
ST Cygni	29.9	+54 38	13.4*d*	SV Androm.	59.2	+39 33	7.8
Y Delphini	36.9	+11 31	10.0 *i*				

The letter *i* denotes that the light is increasing; the letter *d*, that the light is decreasing; the sign <, that the variable is fainter than the appended magnitude.

The above magnitudes have been compiled at the Harvard College Observatory from observations made by the following observers:—H. C. Bancroft, Jr., Mrs. H. C. Bancroft, Jr.. T. C. H. Bouton, L. Campbell, H. O. Eaton, F. H. Hay, J. B. Lacchini, O. Mach, C. Y. McAteer, P. W. Merrill, C. S. Mundt, W. T. Olcott, D. B. Pickering, C. F. Richter, F. H. Spinney, H. W. Vrooman, and I. E. Woods.

Provisional Periods of Three Variables.—In the *Bulletin Astronomique* for May 1915, M. Luizet gives a report of his observations of the three variables 55.1911 Triangulum, 23.1911 Persei, and UX Aurigae. From observations extending from January 10, 1912 to March 20, 1915, the first of these seems to have a period of approximately 165 days. The variation of this star is about 0.5 magnitude, from $7^m.9$ to $8^m.4$.

The second of these seems to be a variable of an irregular period. Observations of this star are made with difficulty because of the distance of the comparison stars from the variable.

The third is also a long period variable. The period assigned is 102.7 days. The varition in magnitude is from about $8^m.3$ to $9^m.0$.

Minima of Variable Stars of Short Period.

[Calculated by Elva Utzinger at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5h; Central Standard 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1915 November
	h m	° ′		d h	d h d h d h d h d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8	
RT Sculptor.	31.5	−26 13	9.6—10.5	0 12.3	1 18; 9 10; 17 3; 24 19
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	6 6; 13 16; 21 3; 28 13
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	1 11; 8 22; 16 9; 23 21
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	6 8; 12 11; 18 14; 24 16
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	2 21; 10 1; 17 4; 24 7
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	2 7; 9 4; 16 0; 22 21
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	5 7; 12 12; 19 16; 26 20
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	6 16; 15 11; 24 5
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	5 14; 13 12; 21 11; 29 10
RX Cassiop.	58.8	+67 11	8.6— 9.1	32 07.6	5 8
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	5 4; 11 12; 17 5; 22 23
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	2 22; 9 17; 16 12; 23 7
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	1 3; 9 1; 16 22; 24 20
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	4 7; 12 14; 20 22; 29 5
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	6 7; 14 4; 22 2; 29 23
RW Persei	13.3	+42 04	8.8—11.0	15 04.8	8 1; 21 6
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	3 5; 12 16; 22 2
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	2 9; 14 19; 27 5
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	3 3; 9 19; 16 11; 23 3
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	4 5; 9 16; 15 3; 20 14
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	2 3; 8 4; 14 4; 20 5
SU Tauri	45.8	+28 05	9.4—11.0	2 04.0	4 22; 13 14; 22 6; 30 22
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	2 10; 12 20; 23 6
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	8 5; 16 5; 24 6
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	2 6; 8 0; 19 11; 30 22
U Columbae	6 11.2	−33 03	9.2—10.0	2 19.2	1 0; 6 15; 17 19; 29 0
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	6 6; 14 11; 22 16; 30 21
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	4 15; 12 6; 19 21; 27 11
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	12 12; 24 18
RU Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	3 18; 10 22; 18 2; 25 6
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	8 15; 17 17; 26 19
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	3 11; 12 19; 22 2
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	6 13; 16 11; 26 9
TX Gemin.	30.3	+17 8	10.0—11.9	2 19.2	4 0; 12 10; 20 20; 29 5
RR Puppis	43.5	−41 08	9.4—10.7	6 10.3	7 0; 13 10; 19 20; 26 7
V Puppis	7 55.4	−48 58	4.1— 4.8	1 10.9	8 1; 15 7; 22 14; 29 20
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	8 12; 16 15; 24 18
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	2 11; 11 22; 21 10; 30 22
RX Hydrae	9 0.8	− 7 52	9.1—10.5	2 6.8	7 18; 16 21; 26 0
S Antliae	27.9	−28 11	6.7— 7.3	0 07.8	1 18; 8 5; 14 17; 21 5
S Velorum	29.4	−44 46	7.8— 9.3	5 22.4	4 9; 10 8; 16 6; 22 5
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	9 10; 17 21; 26 7
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	5 2; 14 8; 23 15
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	6 5; 12 20; 19 10; 26 0
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	5 10; 14 5; 23 0
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	2 19; 10 3; 17 11; 24 19
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	2 20; 19 15; 16 10; 23 5
RZ Centauri	12 55.6	− 64 05	8.5— 8.9	1 21.0	7 5; 14 17; 22 5; 29 17
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	8 0; 15 11; 22 21; 30 7
δ Librae	14 55.6	− 8 07	4.8— 6.2	2 07.9	4 14; 11 14; 18 13; 25 13
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	5 19; 12 16; 19 14; 26 12
TW Draconis	32.4	+64 14	7.3— 8.9	2 19.4	7 7; 15 17; 24 3

Minima of Variable Stars of Short Period—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1915 November
	h m	° ′		d h	d h d h d h d h
SS Librae	15 43.4	−15 14	9.3—11.5	0 18.4	8 12; 16 4; 23 20
SW Ophiuchi	16 11.1	− 6 44	9.2—10.0	2 10.7	3 8; 10 16; 18 0; 25 8
SX Ophiuchi	12.6	− 6 25	10.5—11.2	2 01.5	3 3; 11 9; 19 16; 27 22
R Arae	31.1	−56 48	6.8— 7.9	4 10.2	2 12; 11 8; 20 4; 29 1
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	7 19; 18 20; 28 13
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	6 9; 13 4; 19 23; 26 19
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	2 9; 10 19; 19 4; 27 13
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	2 14; 8 18; 14 21; 21 1
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	3 19; 11 0; 18 5; 25 10
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	6 4; 13 13; 20 22; 28 6
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	8 10; 16 14; 24 19
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	6 21; 14 10; 21 23; 29 12
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	5 7; 13 1; 20 19; 28 13
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	2 8; 10 8; 18 8; 26 7
WX Sagittae	53.6	—17 24	9.2—10.8	2 03.1	5 23; 14 11; 23 0
WY Sagittae	17 54.9	−23 1	9.5—10.6	4 16.0	7 5; 14 17; 22 5; 29 17
SX Draconis	18 03.0	+ 58 23	9.3—10.5	5 04.1	
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	4 7; 11 13; 18 19; 26 1
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	3 4; 10 2; 16 23; 23 21
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 03.2	2 14; 17 17
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	4 2; 12 9; 20 15; 28 21
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	7 8; 16 5; 25 3
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	3 29; 12 13; 20 20; 29 3
RR Draconis	40.8	+62 34	9.3—13	2 19.9	4 4; 12 16; 21 4; 29 15
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	3 11; 10 3; 16 18; 23 10
β Lyrae	46.4	+33 15	3.4— 4.1	12 21.8	3 7; 16 5; 29 2
U Scuti	18 48.9	−12 44	9.1— 9.6	0 22.9	6 12; 16 1; 25 14
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	4 0; 11 14; 19 4; 26 17
RV Lyrae	12.5	+32 15	11. —12.8	3 14.4	2 19; 9 23; 17 4; 24 9
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	1 8; 10 7; 19 6; 28 5
U Sagittae	14.4	+19 26	6.5— 9.0	3 09.1	3 3; 9 21; 16 16; 23 10
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	4 13; 11 22; 19 6; 26 15
TT Lyrae	24.3	+41 30	9.3—11.6	5 05.8	6 1; 11 7; 16 13; 21 19
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	6 18; 13 7; 19 20; 26 8
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	5 7; 11 7; 17 7; 23 7
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	1 7; 7 23; 14 14; 21 5
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	3 0; 12 4; 21 7; 30 11
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	6 6; 14 17; 23 3
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	1 18; 8 13; 15 8; 22 3
UW Cygni	19.6	+42 55	10.5—13	3 10.8	2 18; 9 16; 16 13; 23 11
V Vulpec.	32.3	+26 15	8.2—9.8	37 19.0	30 20
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	5 19; 15 10; 25 1
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	3 0; 12 5; 21 10; 30 14
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	2 7; 9 19; 17 7; 24 19
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	2 14; 8 10; 14 6; 20 2
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	10 13; 20 15; 30 18
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	6 3; 13 12; 20 21; 28 6
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	10 1; 19 18; 29 11
RY Aquarii	14.8	−11 14	8.8—10.4	1 23.2	8 12; 16 9; 24 6
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3	13 0
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	2 6; 12 9; 22 13
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	1 22; 7 3; 17 11; 27 20
X Lacertae	22 45.0	+55 54	8.2— 8.6	5 10.6	1 11; 6 21; 17 18; 28 16
TT Androm.	23 08.7	+45 36	11.3—12.6	2 18.3	5 10; 13 17; 22 0; 30 7
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.4	5 0; 12 12; 20 1; 27 14
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	3 16; 11 22; 20 4; 28 10

Maxima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes and Agnes E. Wells at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5h; Central standard time 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1915. November
	h m	° ′		d h	d h d h d h d h d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.4	36 13.7	
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	7 9; 15 13
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	4 8; 12 1; 19 19; 27 13
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	4 22; 19 17
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	3 21; 11 20; 19 18; 27 17
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	13 0; 20 19; 28 14
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	5 13; 12 20; 20 3; 27 8
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	15
SX Pe sei	4 10.2	+41 27	10.4—11.2	4 07.0	3 16; 12 6; 20 20; 29 10
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	11 6; 22 9
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	1 14; 13 5; 24 20; 6 11
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	7 10; 15 2; 22 18; 30 10
SY Aurigae	05.5	+42 41	8.4— 9.5	10 03.3	1 13; 11 16; 21 20
Y Aurigae	21.5	+42 21	8.6— 9.6	3 20.6	5 19; 13 13
RZ Gemin.	5 56.6	+22 12	9.1—10.0	5 12.7	4 6; 9 18; 15 7; 20 20
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	7 9; 14 23; 22 12; 30 2
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	14 16
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	6 0; 13 5; 20 10; 27 15
W Gemin.	6 29.2	+15 24	6.7— 7.5	7 22.0	8 7; 16 5; 24 3
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	2 14; 12 17; 22 21
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	2 15; 24 21
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	2 2; 10 1; 17 23; 25 22
V Carinae	8 26.7	−59 47	7.4— 8.1	6 16.7	2 16; 9 8; 16 1; 22 18
T Velorum	8 34.4	−47 01	7.6— 8.5	4 15.3	1 5; 10 12; 19 19; 29 1
V Velorum	9 19.2	−55 32	7.5— 8.2	4 08.9	6 17; 15 11; 24 5
Z Leonis	9 46.4	+27 22	7.9— 9.6	59 0.0	
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	7 16; 14 11; 21 6; 28 1
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	4 15; 11 6; 17 20; 24 11
S Muscae	12 07.4	−69 36	6.4— 7.3	9 15.8	2 2; 11 17; 21 9
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	4 4; 12 4; 20 3; 28 3
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	2 13; 9 7; 16 0; 22 18
R Crucis	18.1	−61 04	6.8— 7.9	5 19.8	3 15; 9 11; 15 7; 21 3
S Crucis	12 48.4	−57 53	6.5— 7.6	4 16.6	2 21; 7 13; 16 22; 26 8
W Virginis	13 20.9	− 2 52	8.7—10.4	17 06.5	6 9; 23 16
SS Hydrae	25.0	−23 08	7.4— 8.1	8 4.8	4 10; 12 14; 20 19; 29 0
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	1 4; 8 5; 15 5; 22 6
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	1 12; 9 17; 17 22; 26 3
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	2 4; 8 15; 14 3; 19 15
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	6 23; 14 13; 22 2; 29 15
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	6 17; 14 3; 21 13; 28 23
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	1 20; 8 15; 15 10; 22 4
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	7 1; 13 9; 19 17; 26 0
S Normae	16 10.6	−57 39	6.6— 7.6	9 18.1	0 22; 10 16; 20 10; 30 5
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	7 1; 15 22; 24 18
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	1 8; 7 9; 13 11; 19 12
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	2 17; 9 17; 16 17; 23 17
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9	13 17; 30 20
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	1 2; 8 16; 16 7; 23 21
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	1 22; 7 17; 19 6; 30 19
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	7 18; 14 12; 21 5; 27 23
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	5 21; 16 5; 26 13
Y Lyrae	34.2	+43 52	11.3—12.3	0 12.1	1 6; 7 7; 13 8; 19 9
RZ Lyrae	39.9	+32 42	9.9—11.2	0 12.3	4 5; 10 8; 16 11; 22 14
RT Scuti	18 44.1	−10 30	9.1— 9.7	0 11.9	2 1; 7 23; 13 22; 19 21
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	9 15; 18 17; 27 19

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1915. November					
	h m	° ′		d h	d h	d h	d h	d h	d h	d h
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	2 12;	9 12;	16 13;	23 13		
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	3 7;	10 7;	17 7;	24 6		
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	5 18;	13 17;	21 17;	29 16		
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	7 14;	15 7;	22 23;	30 16		
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	3 3;	10 8;	17 12;	24 16		
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	1 18;	10 3;	18 12;	26 21		
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	4 20;	11 4;	17 11;	23 19		
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	6 10;	22 20				
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	2 20;	11 16;	20 13;	29 10		
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	3 11;	10 5;	16 22;	23 16		
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	3 1;	9 19;	16 12;	23 5		
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4		10 19;	25 12			
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	1 14;	9 10;	17 7;	25 3		
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	7 9;	14 6;	21 4;	28 1		
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	4 19;	14 12;	24 6;	29 3		
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	5 22;	14 13;	23 5			
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	1 6;	6 15;	17 9;	28 2		
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	1 18;	12 15;	23 12			
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	6 21;	13 7;	19 17;	26 3		
V Lacertae	22 44.5	+55 48	8.2— 8.9	4 23.6	5 9;	10 9;	20 8;	30 7		
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	4 15;	10 2;	15 12;	20 27		
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	6 10;	12 17;	19 0;	25 0		
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	1 4;	13 7;	25 11			
V Cephei	23 51.7	+82 38	6.0—7.0	0 23.6	4 22;	9 21;	19 21;	29 23		

Variable Nebula or What?—In my notebook for June 28, 1911 I find the following: R. A. $22^h\ 20^m$ Dec. + 25°, small, faint, slightly elongated nebula. The observation was made with the 6-inch telescope, and, absence from home during the next two weeks precluded the following up of the observation. On my return I examined the region again, but was unable to see the object. The telescope being unprovided with circles, the position is naturally only roughly indicated. Last night I made a careful search with the 16-inch reflector, but failed to find any trace of the object. The question arises whether this is a case of real variability in a nebula, or merely an observation of a wandering comet. I hope those observers possessing adequate optical means will examine this region, which is bounded by the stars ι, ο, β, μ, λ Pegasi.

ALFRED RORDAME.

Salt Lake City, July 18, 1915.

A New Variable.—A new variable, designated 2.1915 Cephei, is announced in a circular from the Pulkowa Observatory. It was discovered by S. Kostinsky and verified by Blajko at Moscow. It was noticed by a stereocomparator examination of two plates. It is quite faint photographically, its variation being from 10^m to 13^m. The position of this star for

1900.0 is $\alpha = 23^h\ 48^m\ 38^s$, $\delta = +\ 75°\ 37'.5$

COMET AND ASTEROID NOTES.

Supposed Comet a Nebula.—A telegram from Yerkes Observatory announced the discovery of a comet by Mr. John E. Mellish on the morning of September 7 in the position

Sept. 6.923 G.M.T. $\alpha = 6^h\ 37^m$ Dec. $+ 8°\ 50'$

The object was observed just as dawn was coming on and there was not time enough to establish its cometary character by any motion, but although small it had a bright nucleus and a tail. Later it was concluded that the object must have been the nebula N.G.C. 2261, given in John Herschel's catalogue as No. 399 and figured in his article in Phil. Trans. for 1833. It is a singular coincidence that the first comet discovered by Mr. Mellish was in the same constellation (Monoceros), and within about a degree of the position of this object. He later discovered another comet in this constellation.

Provisional Orbit Elements of Comet 1915 *a* (Mellish).—From three observations, by Dr. Baldwin for the dates 1915 April 12, April 20 and April 30 an approximate system of parabolic orbit elements of this comet were deduced. An observation by the same observer, for the date 1915 May 17 becoming available, it was used in combination with the first and last ones used in the first determination. The results of the final calculation indicate that these elements were no improvement upon those determined from the shorter arc. They have however been adopted as the basis of the work here given.

It was at first thought that a considerable correction was necessary to the assumed value of the eccentricity, but upon preparing the condition equations it was noted that small errors of observation would have considerable effect upon the time of perihelion passage and the angular distance between the node and perihelion.

The provisional orbit elements here given have been deduced from twelve condition equations, the absolute terms of which were formed from all available data between the dates 1915 February 25 and June 2.

The first and last positions were formed by combining several observations. These were given weight four, the remainder being single observations with weight unity.

The following elements form the basis of this determination:

$$\left.\begin{array}{lrrr} T = & 1915\ \text{July}\ 17.149852\ \text{G.M.T.} & & \\ \omega = & 247° & 44' & 11.6'' \\ \Omega = & 72 & 16 & 35.7 \\ i = & 54 & 46 & 44.8 \end{array}\right\} 1915 \qquad \begin{array}{l} q = 1.0058217 \\ \log q = 0.0025210 \end{array}$$

The equator was adopted as the fundamental plane of reference, the position of this approximate orbit in reference to this plane being

$$\left.\begin{array}{lrrrr} \omega' = & 272° & 33' & 51''.7 & \\ \Omega' = & 59 & 32 & 19 & .2 \\ i' = & 64 & 31 & 27 & .7 \end{array}\right\} 1915$$

we also have

$$\begin{aligned} d\omega_0 &= [9.17112]\ d\Omega' - [9.47192]\ di' \\ d\Omega &= [0.00127]\ d\Omega' - [9.71095]\ di' \\ di &= [9.57871]\ d\Omega' + [9.95788]\ di' \\ d\omega &= d\omega' - d\omega_0 \end{aligned}$$

After the reduction of the condition to the normal equations the following corrections to the preceding elements were determined:

$$\begin{aligned} 10^4\ d\tau &= +\ 53.378 \\ d\omega' &= +126''.02 \\ d\Omega' &= +\ \ 0\ \ .27 \\ di' &= +\ 28\ \ .10 \\ 10^6\ dq &= -544.193. \end{aligned}$$

We therefore have

$$\begin{aligned} d\omega &= +134''.31 \\ d\Omega &= -\ 14\ \ .17 \\ di &= +\ 25\ \ .61. \end{aligned}$$

Assuming the correction to the parabolic eccentricity to be unknown we have the following

PROVISIONAL ORBIT ELEMENTS

Comet 1915 *a* (Mellish).

$$T = 1915\ \text{July}\ 17.155190 - [6.40583]\ de\ \text{G.M.T.}$$

$$\left.\begin{aligned} \omega &= 247^\circ\ 46'\ 25''.9 + 1.033\ de \\ \Omega &= \ \ 72\ \ 16\ \ 21\ \ .5 + 0.139\ de \\ i &= \ \ 54\ \ 47\ \ 10\ \ .4 + 0.375\ de \end{aligned}\right\}\ 1915$$

$$\begin{aligned} q &= 1.0052775 + [4.33565]\ de \\ \log q &= 0.0022860 \\ e &= 1.0 + [5.0000]\ de \end{aligned}$$

The value of "*de*" to be expressed in units of the fifth decimal place, the coefficients within brackets are the logarithms of these quantities.

The value of "*de*" determined from the present calculation is 3.5743, where "*e*" equals 1.0000357... This is so near unity that it has been eliminated. The orbit elements are given in terms of "*de*", so that any value may be adopted at pleasure.

COÖRDINATES.

$$\begin{aligned} x &= [9.7979610]\ r \sin (\ \ 38^\circ\ 46'\ 16''.0 + v) \\ y &= [9.9489556]\ r \sin (348\ \ 24\ \ 24\ \ .7 + v) \\ z &= [9.9556047]\ r \sin (272\ \ 35\ \ 57\ \ .8 + v) \end{aligned}$$

A comparison of the calculated with the observed places, gives the following residuals:

1915	$\cos\delta\, da$ s	$d\delta$ ''
Feb. 26	−0.02	−0.2
Apr. 12	+0.25	+4.7
" 20	−0.36	+1.6
" 30	+0.21	−2.0
May 17	−0.01	0.0
June 1	−0.01	+0.1

Similar residuals are obtained by introducing the values of the unknown quantities, determined from the normal equations, into the condition equations. An ephemeris is appended.

COMET 1915 *a* (MELLISH).

EPHEMERIS.

Greenwich Mean Noon.

1915		α app. h m s	δ app. ° ′ ″	log *r*	log Δ
July	22	6 10 43.04	−36 12 44.5	0.00377	9.96395
	23	6 11 35 51	−35 55 14.6		
	24	6 12 26.15	−35 18 22.9	0.00523	9.97480
	25	6 13 15.11	−34 52 7.7		
	26	6 14 2.45	−34 26 27.5	0.00717	9.98503
	27	6 14 48.28	−34 1 21.0		
	28	6 15 32.65	−33 36 46.7	0.00958	9.99466
	29	6 16 15.63	−33 12 43.6		
	30	6 16 57.27	−33 49 10.4	0.01244	0.00370
	31	6 17 37.66	−33 26 6.3		
Aug.	1	6 18 16.82	−32 3 30.2	0.01573	0.01217
	2	6 18 54.82	−31 41 21.3		
	3	6 19 31.68	−31 19 38.5	0.01942	0.02009
	4	6 20 7.42	−30 58 21.4		
	5	6 20 42.04	−30 37 28.5	0.02349	0.02749
	6	6 21 15.60	−30 16 59.9		
	7	6 21 48.07	−29 56 54.8	0.02792	0.03438
	8	6 22 19.46	−29 37 12.1		
	9	6 22 49.76	−29 17 51.6	0.03267	0.04077
	10	6 23 19.02	−28 58 52.7		
	11	6 23 47.20	−28 40 14.5	0.03772	0.04669
	12	6 24 14.30	−28 21 56.7		
	13	6 24 40.30	−28 3 58.5	0.04304	0.05215
	14	6 25 5.21	−27 46 19.5		
	15	6 25 29.02	−27 28 59.1	0.04861	0.05717
	16	6 25 51.69	−27 11 56.9		
	17	6 26 13.23	−26 55 12.1	0.05440	0.06176
	18	6 26 33.63	−26 38 44.1		
	19	6 26 52.86	−26 22 33.3	0.06038	0.06594
	20	6 27 10.91	−26 6 38.4		
	21	6 27 27.75	−25 50 59.2	0.06653	0.06972
	22	6 27 43.39	−25 35 35.3		
	23	6 27 57.79	−25 20 26.3	0.07283	0.07313
	24	6 28 10.93	−25 5 31.8		
	25	6 28 22.78	−24 50 51.5	0.07925	0.07617
	26	6 28 33.33	−24 36 24.9		
	27	6 28 42.55	−24 22 11.8	0.08577	0.07886
	28	6 28 50.40	−24 8 11.6		
	29	6 28 56.83	−23 54 24.1	0.09238	0.08120
	30	6 29 1.84	−23 40 48.9		
	31	6 26 5.37	−23 27 25.5	0.09906	0.08321
Sept.	1	6 29 7.39	−23 14 13.5		
	2	6 29 7.85	−23 1 12.5	0.10579	0.08491
	3	6 29 6.75	−22 48 22.0		
	4	6 29 4.01	−22 35 41.7	0.11256	0.08631

C. J. MERFIELD.

Melbourne Observatory, 1915, July 1.

Ephemeris of Winnecke's Comet.—This comet passed perihelion about the first of September and was nearest the earth September 24. At its nearest approach, however, it was farther away than the sun, so that it has been observed only under unfavorable conditions. During October and November it will be too far south for observation in our latitude. Observers in the southern hemisphere should be able to follow the comet for some time yet.

EPHEMERIS FOR BERLIN MIDNIGHT.

[From *Astronomische Nachrichten* No. 4810.]

		App. α	App. δ	log r	log Δ
		h m s	° ′ ″		
Oct.	5	16 53 30.67	−33 36 13.8	0.037815	0.014788
	6	16 59 22.40	34 03 52.6		
	7	17 05 16.70	34 30 20.8		
	8	11 13.38	34 55 36.7		
	9	17 12.21	35 19 39.0	0.048221	0.020718
	10	23 12.96	35 42 26.4		
	11	29 15.38	36 03 57.8		
	12	35 19.21	36 24 12.4		
	13	41 24.18	36 43 09.5	0.059070	0.028316
	14	47 30.01	37 00 48.6		
	15	53 36.41	37 17 09.5		
	16	17 59 43.10	37 32 12.0		
	17	18 05 49.78	37 45 56.3	0.070248	0.037469
	18	11 56.15	37 58 22.6		
	19	18 01.93	38 09 31.5		
	20	24 06.82	38 19 23.4		
	21	30 10.53	38 27 59.2	0.081648	0.048037
	22	36 12.79	38 35 19.8		
	23	42 13.33	38 41 26.4		
	24	48 11.88	38 46 20.2		
	25	18 54 08.19	38 50 02.8	0.093178	0.059866
	26	19 00 02.02	38 52 35.7		
	27	05 53.16	38 54 00.5		
	28	11 41.39	38 54 18.9		
	29	17 26.51	38 53 32.8	0.104759	0.072789
	30	23 08.36	38 51 44.0		
	31	28 46.76	38 48 54.5		
Nov.	1	34 21.56	38 45 06.2		
	2	39 52.63	38 40 21.2	0.116332	0.086637
	3	45 19.83	38 34 41.5		
	4	50 43.06	38 28 09.3		
	5	19 56 02.22	38 20 46.6		
	6	20 01 17.23	38 12 35.5	0.127841	0.101237
	7	06 28.02	37 03 38.2		
	8	11 34.53	37 53 56.8		
	9	16 36.72	37 43 33.4		
	10	21 34.55	37 32 30.1	0.139247	0.116433
	11	26 28.00	37 20 49.0		
	12	31 17.06	37 08 31.9		
	13	36 01.73	36 55 40.6		
	14	40 42.03	36 42 17.0	0.150513	0.132073
	15	20 45 17.98	−36 28 22.9		

Ephemeris of Comet 1913 *f* (Delavan).—This comet, which was discovered nearly two years ago and is now far out on its journey away from the sun, may still be followed with large telescopes in the southern hemisphere. The following ephemeris, calculated by G. Van Biesbroeck of Uccle, Belgium, is taken from the *Astronomische Nachrichten* No. 4786.

EPHEMERIS FOR GREENWICH MEAN NOON.

1915	True α	True δ	log *r*	log Δ	Mag.	Aberration Time
	h m s	° ′				m s
Oct. 5	15 28 35	−51 43.1	0.65799	0.69804	10.0	41 27
9	32 49	51 51.9				
13	37 20	52 01.6				
17	41 37	52 12.2	0.66917	0.71810	10.1	43 25
21	46 10	52 23.4				
25	50 48	52 35.4				
28	15 55 31	52 48.1	0.67997	0.73558	10.3	45 12
Nov. 2	16 00 18	53 01.4				
6	05 09	53 15.3				
10	10 03	53 29.8	0.69042	0.75053	10.4	46 47
14	15 00	53 44.9				
18	20 00	54 00.5				
22	25 02	54 16.6	0.70054	0.76301	10.5	48 09
26	30 06	54 33.2				
30	35 11	54 50.4				
Dec. 4	40 18	55 08.0	0.71035	0.77314	10.6	49 17
8	45 24	55 26.1				
12	50 31	55 44.6				
16	16 55 37	56 03.7	0.71987	0.78101	10.7	50 11
20	17 00 42	56 23.2				
24	05 46	56 43.3				
28	10 48	57 03.8	0.72914	0.78678	10.8	50 51
32	17 15 47	−57 24.8				

New Comet 1915 *d* (Mellish).—A new comet is announced as discovered by Mellish at the Yerkes Observatory on September 18. It was then in the constelation Leo Minor and moving eastward and southward. This motion, if continued in the same direction, will carry the comet through the southern part of Coma Berenices early in November. It is visible in a small telescope.

Professor Frost writes that the object was first seen by Mr. Mellish on the night of the 13th, and he caught glimpses of it later through unfavorable skies; but it was not until the 18th that a fairly close position could be obtained, just before dawn, by Mr. VanBiesbroeck with the 12-inch telescope. Accurate positions were also obtained by the same observer on the 20th and 21st.

On the 20th, the total brightness was estimated by Mr. Van Biesbroeck as equivalent to the 9th magnitude. The comet was round, about 2′ in diameter, with a central condensation.

The following observations have come to hand:

	G. M. T.	α	δ	Observer	Place
		h m s	° ′ ″		
Sept.	18.9479	10 28 42	+26 38 37±	Van Biesbroeck	Williams Bay
	20.0197	10 37 03.6	+26 13 17	Aitken	Mt. Hamilton
	20.9414	10 44 18.5	+25 49 32	Van Biesbroeck	Williams Bay
	21.9320	10 52 11.8	+25 11 51	"	"

Ephemeris of Comet 1915 *a* (Mellish).—The following is an extension of the ephemeris given on page 440 of the August-September number of POPULAR ASTRONOMY.

EPHEMERIS FOR GREENWICH MIDNIGHT.

	α	δ	log *r*	log Δ	Br.
	h m s	° ′ ″			
Nov. 1.5	5 19 40.9	−9 41 48	0.29500	0.07167	1.23
5.5	10 04.8	8 23 56	.30556	.07502	1;16
9.5	5 00 14.7	7 02 12	.31586	.08013	1.08
13.5	4 50 20.8	5 37 08	.32592	.08732	0.99
17.5	40 32.6	4 09 58	.33574	.09642	0.91
21.5	30 59.5	2 41 44	.34533	.10748	0.83
25.5	21 50.4	−1 13 34	.35470	.12036	0.75
29.5	4 10 09.2	+0 13 25	0.36385	0.13496	0.67

Brightness Feb. 13, 1915 taken as 1.0

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers, June, July, August, 1915.

In spite of the fact tnat there is much of interest in this report relative to the variables that have been under observation, the unusual length of the record precludes extended comment. The thanks of the Association is due Mr. A. B. Burbeck for the able and efficient service he rendered during his term as secretary. It is no small task to handle the reports as Mr. Burbeck can now testify, and the fact that in spite of the demands of business he was willing to assume this additional burden, indicates his interest in the work of the association, and increases our debt of gratitude to him.

We welcome to our ranks this month two new members:

Mr. David Wilson, "W" of Philadelphia, Pa., and

Mr. Charles K. Arter, "A" of Cleveland, O.

It is a pleasure to note the gradual and steady growth of our Association, and the wider influence that attends it.

Mr. Richter, not content with breaking our observing records in June with a list of 669 estimates, sent in for his July report 813 observations and 820 for August, truly a splendid tribute to his zeal and diligence, Mr. Richter is deserving of high commendation for the consistent and valuable work he is doing, and we congratulate him on his achievements.

The secretary during his absence from home, in addition to the pleasure of visiting the Mt. Wilson, Lick, University of California, University of Wisconsin, and Yerkes Observatories, enjoyed meeting the following members of the Association: Messrs. Craig, Richter, Hay, Gray, Bolfing, Mundt, and Eaton. It was an inspiration to meet these kindred spirits and greet in person so many correspondents of long standing.

Mr. Charles B. Lindsley, of Berea, Ky., leaves this month to reside in Cincinnatti, O. It is hoped that he will be able to popularize Variable Star observing in Cincinnatti where there is already a live interest in Astronomy.

We are indebted to Mrs. H. C. Bancroft, Jr. for a number of observations which appear in this report under the abbreviation "MBa".

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915.

001046
X Androm.

Mo.	Day	Est.	Obs.
8	10	12.0	Ba
	17	12.4	B

001726
T Androm.

Mo.	Day	Est.	Obs.
7	16	12.3	E
8	8	11.8	E
	10	11.7	Ba
	11	11.3	Sp
	15	11.3	Sp
	16	11.2	Sp
	17	11.1	Ba
	17	11.2	Sp

001755
T Cassiop.

Mo.	Day	Est.	Obs.
7	9	10.0	M
	24	10.0	Sp
8	10	11.2	Sp
	11	11.0	O
	11	11.3	Sp
	13	10.4	M
	16	11.1	B
	17	10.4	Ba

001838
R Androm.

Mo.	Day	Est.	Obs.
7	9	8.4	M
8	6	9.7	E
	10	9.3	Ba
	11	10.0	O
	11	9.6	Sp
	14	9.6	Sp
	15	9.7	Sp
	16	9.7	Sp
	17	9.8	M
	17	9.5	Sp
	17	9.6	Ba

004047
U Cassiop.

Mo.	Day	Est.	Obs.
7	9	9.6	M
8	13	10.0	M
	13	12.8	Ba
	16	12.7	B

004132
RW Androm.

Mo.	Day	Est.	Obs.
8	8	10.9	E
	11	10.8	Sp
	17	10.8	Ba
	19	10.9	M

004746
RV Cassiop.

Mo.	Day	Est.	Obs.
8	13	11.1	Ba
	13	11.2	M

004958
W Cassiop.

Mo.	Day	Est.	Obs.
7	9	8.9	M
	25	9.2	Ba
	26	9.4	M

RV Cassiop.

Mo.	Day	Est.	Obs.
8	7	9.6	Ba
	10	9.3	Sp
	11	9.3	Sp
	13	10.0	M
	13	9.8	Ba
	16	9.4	Sp
	16	8.9	B

010940
U Androm.

Mo.	Day	Est.	Obs.
8	8	13.5	E

011272
S Cassiop.

Mo.	Day	Est.	Obs.
7	9	10.5	M
8	6	11.0	M
	11	11.4	Sp
	13	11.3	M
	16	11.2	B
	17	11.5	Ba

011712
U Piscium

Mo.	Day	Est.	Obs.
8	8	11.7	E
	13	11.3	M
	17	11.7	Ba

012350
RZ Persei

Mo.	Day	Est.	Obs.
8	14	10.5	M
	17	10.4	Ba

012502
R Piscium

Mo.	Day	Est.	Obs.
8	8	11.4	E
	13	11.2	M
	17	11.4	Ba

014958
X Cassiop.

Mo.	Day	Est.	Obs.
7	9	10.5	M
8	6	11.2	M
	16	11.2	B
	17	11.5	Ba

015254
U Persei

Mo.	Day	Est.	Obs.
8	10	9.7	Pi
	10	10.7	Sp
	12	10.8	Sp
	14	11.0	M
	15	10.8	Sp
	17	10.8	Ba
	18	10.7	Sp

021024
R Arietis

Mo.	Day	Est.	Obs.
8	8	9.2	M
	11	10.1	R
	15	8.9	Ba
	18	9.7	R
	19	9.2	E

021403
o Ceti

Mo.	Day	Est.	Obs.
7	8	8.3	R
	12	8.1	L
8	8	8.6	M
	8	8.8	E
	8	8.8	L
	11	9.0	R
	18	8.5	R
	19	8.9	E

021658
S Persei

Mo.	Day	Est.	Obs.
7	6	8.7	R
	8	8.9	R
	9	8.7	Ba
	11	8.8	R
	16	9.3	Pi
	16	9.5	E
8	10	8.8	Sp
	11	9.4	R
	11	8.9	Sp
	15	8.8	Sp
	16	8.7	Sp
	17	8.5	Ba
	18	8.6	R
	18	8.6	Sp

023133
R Triang.

Mo.	Day	Est.	Obs.
7	14	7.7	M
8	13	8.6	M
	15	8.3	Ba
	18	8.4	Sp

024356
W Persei

Mo.	Day	Est.	Obs.
6	23	9.5	R
7	5	9.8	R
	8	9.8	R
	8	9.8	Ly
	9	9.5	M
	11	9.7	R
	12	9.2	L
	14	10.0	M
	16	9.8	Pi
	16	9.2	E
8	8	9.8	M
	11	9.8	R
	17	9.2	Ba
	17	9.4	Pi
	17	9.6	L
	17	9.9	R
	18	9.7	R

031401
X Ceti

Mo.	Day	Est.	Obs.
8	8	11.6	E

032043
Y Persei

Mo.	Day	Est.	Obs.
7	6	9.0	R
	8	10.0	R
	11	9.8	R
	14	9.2	M
	16	9.5	E
8	9	9.3	M
	11	9.6	R
	17	8.4	Ba
	18	9.4	R

032335
R Persei

Mo.	Day	Est.	Obs.
8	8	11.1	E
	17	11.0	Ba

033362
U Camelop.

Mo.	Day	Est.	Obs.
7	6	8.4	R
	8	8.4	R
	11	8.2	R
8	11	8.6	R
	17	7.1	Ba
	18	9.3	R
	18	7·5	Ma

042209
R Tauri

Mo.	Day	Est.	Obs.
8	8	10.0	M
	8	9.7	E
	18	10.0	Sp

042215
W Tauri

Mo.	Day	Est.	Obs.
8	7	10.6	M
	15	10.6	Ba
	22	10.7	M

043065
T Camelop.

Mo.	Day	Est.	Obs.
7	16	10.3	E

043274
X Camelop.

Mo.	Day	Est.	Obs.
6	11	8.0	L
7	6	8.4	L
	12	9.5	L
8	17	12.5	L

043208
RX Tauri

Mo.	Day	Est.	Obs.
8	8	11.5	E

045514
R Leporis

Mo.	Day	Est.	Obs.
8	8	8.0	L

050953
R Aurigae

Mo.	Day	Est.	Obs.
8	9	10.0	M
	13	9.8	M

052034
S Aurigae

Mo.	Day	Est.	Obs.
8	7	8.8	M
	8	10.5	L

052036
W Aurigae

Mo.	Day	Est.	Obs.
8	8	11.4	M
	18	10.7	R

053068
S Camelop.

Mo.	Day	Est.	Obs.
8	14	9.3	M

055353
Z Aurigae

Mo.	Day	Est.	Obs.
7	16	9.6	E
8	8	9.5	E

060450
X Aurigae

Mo.	Day	Est.	Obs.
7	12	8.3	L
8	8	10.2	L

060547
SS Aurigae

Mo.	Day	Est.	Obs.
8	8	12.0	L
	8.8	12.2	E
	9.8	12.9	E

081112
R Cancri

Mo.	Day	Est.	Obs.
5	30	7.1	R
6	3	7.5	R
	4	7.5	R
	6	7.4	R
	7	7.6	R

081617
V Cancri

Mo.	Day	Est.	Obs.
5	30	7.9	R
6	3	8.3	R
	4	7.7	R
	6	7.6	R
	7	7.8	R

084803
S Hydrae

Mo.	Day	Est.	Obs.
5	30	9.2	R
6	4	9.6	R
	6	9.9	R
	7	10.1	R
	10	10.2	R

085120
T Cancri

Mo.	Day	Est.	Obs.
6	11	9.3	L

090151
V Urs. Maj.

Mo.	Day	Est.	Obs.
5	30	10.0	R
6	3	9.9	R
	4	10.3	R
	6	10.4	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

103769
V Urs. Maj.

Mo.	Day	Est.	Obs.
6	7	10.5	R
	10	10.4	R
	11	10.2	Hy
	11	10.6	R
	12	10.2	Hy
	12	10.6	R
	13	10.4	R
	14	10.0	R
	15	10.2	R
	16	10.4	R
	17	10.3	R
	17	9.9	Hy
	18	9.8	R
	20	10.0	Hy
	28	9.8	R
7	2	9.6	R
	3	10.0	R
	4	9.7	R
	5	10.3	R
	6	10.4	Ba
	7	10.1	R
	8	10.3	R
	8	10.4	Pi

090425
W Cancri

Mo.	Day	Est.	Obs.
6	12	8.4	L

093934
R Leo. Min.

Mo.	Day	Est.	Obs.
5	30	10.6	R
6	3	10.4	R
	4	10.4	R
	6	10.4	R
	7	10.3	R

094211
R Leonis

Mo.	Day	Est.	Obs.
5	30	9.7	R
6	3	9.7	R
	4	9.5	R
	6	9.5	R
	7	9.5	R
	10	9.6	L
	10	9.9	R
	11	10.0	R
	12	10.2	R
	13	9.3	Hy
	13	10.3	R
	14	10.3	R
	15	10.3	R
	16	10.3	R
	18	10.4	R
	28	10.3	R
7	2	9.5	R
	3	9.8	R

R Urs. Maj.

Mo.	Day	Est.	Obs.
5	30	10.6	R
6	3	10.1	R
	4	10.2	R
	6	10.3	R
	7	10.3	R
	10	10.6	R
	11	10.4	R
	11	10.0	Hy
	12	10.4	R
	12	10.0	Hy
	13	10.6	R
	14	10.7	R
	15	10.7	R
	16	10.8	R
	17	10.2	Hy
	17	10.9	R
	18	10.9	R
	20	10.1	Hy
	28	11.0	B
7	2	11.4	R
	3	11.5	R
	4	11.5	R
	5	11.5	R
	6	11.4	Ba
	7	11.4	R
	8	11.5	R
	9	11.5	R
	10	11.5	R
	13	11.7	E
	18	11.8	Ba
8	17	12.3	Ba

104620
V Hydrae

Mo.	Day	Est.	Obs.
6	4	9.1	R
	6	9.1	R
	7	9.2	R
	10	9.3	R
	11	9.0	R
	12	9.1	R
	13	9.0	R
	14	9.1	R
	15	9.1	R
	16	9.2	R
	17	9.2	R
	18	9.2	R

115919
R Comae

Mo.	Day	Est.	Obs.
6	14	9.8	R
	15	9.4	R
	16	9.5	R
	17	9.4	R
	18	9.2	R
	24	8.9	B
	26	9.4	R
	27	9.5	R
	28	9.6	R
7	2	9.4	R
	3	9.5	R

R Comae

Mo.	Day	Est.	Obs.
7	4	9.6	R
	5	9.5	R
	7	9.6	R
	8	9.6	R
	9	9.7	R
	10	9.8	R
	11	9.8	R
	12	9.8	R
	13	9.8	R
	14	9.9	R
	15	10.0	R
	18	9.9	R
	20	9.8	R

121418
R Corvi

Mo.	Day	Est.	Obs.
5	30	8.2	R
6	3	8.1	R
	4	8.2	R
	6	8.1	R
	6	8.0	L
	7	8.2	R
	10	8.3	Hy
	10	8.1	R
	11	8.3	Hy
	11	8.1	R
	12	8.2	Hy
	12	8.2	R
	12	8.7	L
	13	8.2	R
	13	8.4	Hy
	14	8.2	R
	15	8.2	R
	16	8.3	R
	17	8.3	R
	17	8.2	Hy
	18	8.3	R
	26	8.4	R
	26	7.8	B
	27	8.5	R
	28	8.6	R
7	2	8.8	R
	3	8.8	R
	4	8.9	R
	5	9.0	R
	7	9.0	R
	8	9.1	R
	9	9.2	R
	10	9.3	R
	11	9.4	R
	12	9.4	R
	13	9.6	R
	14	9.5	R
	15	9.6	R

122001
SS Virginis

Mo.	Day	Est.	Obs.
6	28	8.5	B
7	9	7.6	Ba

122532
T Can. Ven.

Mo.	Day	Est.	Obs.
7	6	9.4	Ba
	12	9.4	Ba
	18	9.2	Ba
	18	9.3	MBa
8	10	9.3	Ba
	17	9.4	Ba

122803
Y Virginis

Mo.	Day	Est.	Obs.
6	6	10.1	L
	24	9.8	B
7	4	10.2	L
	9	10.3	Ba

123160
T Urs. Maj.

Mo.	Day	Est.	Obs.
7	6	12.3	Ba
	18	12.0	Ba
	23	11.9	B
	31	11.1	M
8	4	9.6	O
	7	9.4	Ba
	9	9.4	O
	9	9.1	E
	9	9.2	Ba
	12	8.7	R
	13	8.8	Ba
	13	8.6	Pi
	13	8.6	R
	14	8.6	R
	14	8.6	O
	15	8.9	M
	15	8.5	Ma
	15	8.3	R
	16	8.7	O
	16	8.3	R
	17	8.7	M
	17	8.5	Ba
	17	8.1	R
	18	8.1	R
	19	8.1	R
	20	8.0	R
	22	7.9	R
	23	7.9	Ba
	25	8.3	M
	30	7.8	Ba
	30	8.2	M
9	7	8.1	O

123307
R Virginis

Mo.	Day	Est.	Obs.
5	30	8.6	R
	30	9.5	Hy
6	3	9.7	R
	4	9.7	R
	6	10.0	L
	6	9.8	R
	7	10.1	R
	7	9.8	Hy
	10	10.4	R
	10	9.9	Hy

R Virginis

Mo.	Day	Est.	Obs.
6	11	10.2	R
	11	10.2	Hy
	12	10.4	L
	12	10.3	R
	12	10.3	Hy
	13	10.2	R
	13	10.4	Hy
	14	10.5	R
	15	10.5	R
	16	10.4	R
	17	10.6	R
	17	10.3	Hy
	18	10.5	R
	24	10.5	B
7	2	10.8	R
	3	10.6	R
	4	10.6	L
	4	10.9	R
	5	10.6	R
	7	10.3	R
	8	10.1	R
	9	10.0	R
	9	10.0	Ba
	10	9.8	R
	11	10.0	R
	11	9.8	L
	12	9.9	R
	13	9.6	R
	14	9.4	R
	15	9.5	R
	18	8.8	R
	20	8.9	R
	22	8.7	R
	27	8.0	R
	28	8.0	R
	30	8.0	R
	31	7.8	R
8	1	7.8	L
	6	7.6	R
	10	7.0	R
	11	7.4	R
	12	7.2	R
	13	7.4	R
	14	7.3	R

123459
RS Urs. Maj.

Mo.	Day	Est.	Obs.
7	31	12.2	M

123961
S Urs. Maj.

Mo.	Day	Est.	Obs.
5	25	8.5	L
	30	8.6	R
6	3	8.7	R
	4	8.7	R
	6	8.7	R
	7	8.7	R
	10	8.6	R
	11	8.5	R
	12	8.5	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

S Urs. Maj.				S Urs. Maj.				R Hydrae				R Can. Ven.				S Boötis			
Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.
6	13	8.3	R	8	8	9.3	Ma	6	7	5.1	R	6	14	10.7	R	8	5	10.3	L
	14	7.9	R		8	9.0	O		10	5.2	R		15	10.5	R		6	10.3	R
	15	7.7	R		9	9.7	R		11	5.2	R		16	10.4	R		7	10.0	Ba
	16	7.7	R		9	9.3	E		12	5.0	L		17	10.9	R		9	9.9	O
	17	7.8	R		10	9.0	O		12	5.3	R		18	11.0	R		10	10.0	R
	18	8.1	R		10	9.8	R		13	5.3	R	7	2	11.0	R		11	9.6	B
	23	8.4	R		11	9.6	R		14	5.3	R		3	10.6	R		11	10.0	R
	23	8.1	B		12	9.6	R		15	5.4	R		4	11.2	R		12	9.9	R
	24	8.3	R		13	9.0	Pi		16	5.4	R		5	11.3	R		13	9.8	R
	25	8.2	R		13	9.8	R		17	5.5	R		6	10.8	L		13	9.4	Pi
	26	8.0	R		13	9.1	Ba		18	5.5	R		6	11.0	Ba		13	9.8	Ba
	26	7.7	M		14	9.2	O		28	5.7	R		7	11.3	R		14	9.5	O
	27	8.1	R		14	9.5	R	7	2	5.7	R		8	10.0	Ly		14	9.5	R
	27	7.6	M		15	9.5	L		3	5.8	R		8	11.5	R		15	9.4	R
	28	8.1	R		15	9.6	R		4	5.8	R		10	11.5	R		16	9.1	R
7	1	7.8	Ly		15	9.2	M		4	5.6	L		10	10.4	M		18	9.4	Ba
	2	8.0	R		16	9.2	O		5	5.8	R		11	11.5	R		18	9.0	R
	3	8.0	R		16	9.5	R		7	5.8	R		12	10.8	Pi		19	8.9	R
	4	8.1	R		17	9.2	Ba		8	5.9	R		12	11.5	R		20	8.8	R
	5	8.4	R		17	9.4	R		9	6.4	Mu		13	11.5	E		22	8.8	R
	6	8.6	R		18	9.3	B		10	6.0	R		13	11.6	R		23	9.2	Ba
	6	8.1	L		18	9.5	R		11	6.1	R		14	11.7	R		30	8.9	Ba
	6	7.7	Ba		19	9.6	R		11	5.8	L		15	11.5	R	9	7	8.7	O
	7	8.6	R		20	9.5	R		12	6.1	R		18	11.6	R				
	8	8.6	R		23	9.7	Ba		13	6.3	R		18	11.4	Ba		142205		
	8	7.8	L		25	10.4	M		14	6.2	R		21	11.0	Ly		RS Virginis		
	9	8.6	R		30	10.3	Ba		15	6.2	R		29	12.0	B	6	6	8.0	L
	10	8.0	Pi						18	6.1	R	8	5	11.5	L		12	7.9	L
	10	8.6	R						28	6.1	R		7	11.5	Ba		24	7.9	E
	11	8.6	R		124204				30	6.5	R		17	12.0	Ba	7	4	7.9	L
	11	8.0	Ma		RU Virginis				31	6.5	R						9	7.7	Ba
	12	8.7	R	6	28	11.7	B	8	6	6.2	R						9	8.0	MBa
	12	8.2	E	7	4	11.6	L						140113				11	8.1	L
	12	7.8	Ba		7	10.5	R						Z Bootis			8	4	8.3	L
	13	8.4	L		8	10.2	R		*132706*			7	9	13.6	Ba				
	13	8.7	R		9	10.2	R		S Virginis								142539		
	14	8.6	R		9	11.6	Ba	6	6	11.8	L		141567				V Bootis		
	15	8.6	R		10	9.9	R		12	11.8	L		U Urs. Min.			5	25	9.2	L
	17	8.3	Ma		11	10.3	R	7	9	12.3	Ba	7	6	11.7	Ba		30	9.4	R
	18	9.0	R		12	10.2	R						12	11.3	Pi	6	3	9.5	R
	18	8.4	MBa		13	10.1	R		133273				16	11.6	E		4	9.4	R
	18	8.1	Ba		14	11.6	L		T Urs. Min.				17	11.5	Pi		6	9.5	R
	19	8.4	M		14	10.2	R	7	6	12.5	Ba		18	12.0	Ba		7	9.5	R
	20	9.1	R		15	10.3	R		18	12.0	Ba	8	9	11.5	Ba		10	9.6	R
	22	9.1	R	8	1	11.1	L	8	7	10.2	Ba		17	11.6	Ba		11	9.1	Hy
	24	8.3	Ba						13	10.0	Ba		25	11.5	B		11	9.6	R
	24	8.4	MBa		124606				18	9.9	Ba		30	11.1	Ba		12	9.0	Hy
	27	9.3	R		U Virginis				30	9.6	Ba						12	9.8	R
	28	9.2	R	6	12	11.8	L										13	9.6	R
	30	8.1	Ly		28	12.3	B		134440				141954				13	9.2	Hy
	30	9.3	R	7	9	11.7	Ba	R	Can. Venat.				S Bootis				14	9.9	R
	31	8.6	M					5	30	10.0	R	7	6	12.2	L		15	9.4	R
	31	9.4	R		*132422*			6	3	9.9	R		6	12.1	Ba		16	9.3	R
8	2	9.0	Ma		R Hydrae				4	10.0	R		12	11.8	Ba		17	9.3	Hy
	4	8.8	O	5	30	5.2	R		7	10.1	R		16	11.6	E		17	9.2	R
	6	9.5	R	6	3	5.0	R		10	10.2	R		18	11.8	Ba		18	9.4	R
	7	9.5	R		4	5.0	R		11	10.2	R		24	11.2	Ba		20	9.1	Hy
	7	8.7	Ba		6	4.8	L		12	10.5	R		30	10.8	R		22	10.4	R
					6	5.0	R		13	10.5	R		31	10.9	R		27	10.0	M

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

V Bootis				R Camelop.				142584				R Bootis				S Librae				S Cor. Bor.			
Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.		Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.
7	2	9.8	R	6	11	11.2	L	7	18	10.9	Hy	7	12	9.4	R	7	6	10.5	Ba
	3	9.6	R	7	6	9.5	L	8	4	12.2	L		13	9.3	R		8	10.4	Ly
	4	10.2	L		9	8.8	Ba		10	12.0	Ba		14	9.4	R		14	10.6	Pi
	4	9.6	R		9	8.9	MBa		11	11.8	B		15	9.1	R		17	10.6	Pi
	5	9.7	R		13	9.1	L						18	9.2	R		18	11.0	Ba
	6	9.9	Pi		18	8.8	Ba		144918				27	9.1	R		21	10.6	Ly
	6	10.1	Ba		24	8.8	Ba		U Bootis				28	9.1	R	8	10	12.0	Ba
	7	10.0	R	8	9	8.7	O	7	3	10.8	V		30	9.1	R		11	12.0	B
	7	9.5	Hy		14	8.5	Ba		8	11.0	Ba		31	9.0	R				
	8	10.1	R		17	8.7	L		16	10.8	V	8	6	9.8	R		*151822*		
	8	10.0	Ly		18	8.5	Ba		18	11.1	Ba		7	8.8	L		RS Librae		
	9	10.0	R		24	8.4	B		30	10.8	V		10	9.6	R	6	11	11.9	L
	10	10.0	R		143227			8	6	10.8	V		11	9.8	R	7	4	11.5	L
	10	10.0	Pi		R Bootis				10	11.1	Ba		12	9.6	R	8	16	9.7	B
	11	10.1	R	5	30	8.4	R		10	10.7	B		13	9.7	R				
	12	10.0	R	6	3	8.9	R		14	10.7	V		14	9.7	R		*152714*		
	12	10.1	E		4	8.8	R		14	11.0	Ba		15	9.4	R		RU Librae		
	13	9.0	L		6	9.0	R									5	30	9.1	R
	13	10.0	R		7	9.2	R		*150018*				151614			6	3	8.6	R
	14	9.8	Hy		10	9.2	R		RT Librae				S Serpentis				4	8.6	R
	14	10.1	R		11	9.2	Hy	6	10	10.1	L	6	16	11.7	L		6	8.5	R
	15	9.6	Hy		11	9.4	R					7	3	11.1	V		6	8.3	L
	15	9.9	R		12	9.2	Hy		*150519*				7	10.0	L		7	8.5	R
	16	9.7	Hy		12	9.5	R		T Librae				9	9.4	MBa		10	8.2	R
	17	9.9	Pi		13	9.3	Hy	6	10	12.0	L		9	9.5	Ba		11	8.5	Hy
	18	9.9	R		13	9.6	R	7	6	12.0	L		11	9.7	V		11	8.1	R
	18	10.2	Ba		14	9.7	R	8	5	12.0	L		16	9.2	E		12	8.3	L
	18	9.8	Hy		15	9.7	R						16	9.6	V		12	8.6	Hy
	19	10.4	M		16	9.7	R		*150605*				30	9.1	V		12	8.0	R
	20	9.9	R		17	9.0	Hy	6	Y Librae				31	8.6	L		13	8.6	Hy
	22	9.8	R		17	9.8	R		6	9.6	L	8	6	8.7	V		13	7.9	R
	25	10.2	Ba		18	9.7	R	7	12	9.9	L		10	8.6	Ba		14	7.9	R
	27	9.8	R		20	9.0	Hy		4	10.8	L		14	8.6	V		15	7.8	R
	28	9.9	R		22	10.0	R		8	11.5	Pi		17	8.5	Ba		16	7.7	R
	30	9.9	R		27	10.5	M		8	11.3	Ba		28	9.1	V		17	8.4	Hy
	31	9.9	R		28	10.4	R		*151520*								17	7.7	R
8	4	9.5	L	7	1	10.6	Ly		S Librae				151731				18	8.0	R
	6	9.7	R		2	10.5	R	6	6	10.5	R		S Cor. Bor.				20	8.3	Hy
	7	9.7	R		3	10.7	R		7	10.6	R	5	30	9.5	R		26	7.7	R
	9	9.6	O		4	10.6	R		10	9.9	L	6	3	9.7	R		27	8.0	R
	9	10.0	Ba		5	11.1	R		10	10.6	R		4	9.7	R		28	8.0	R
	10	9.7	R		6	11.0	L		11	10.5	R		6	10.1	R	7	2	8.3	R
	11	9.5	R		6	11.1	Ba		12	10.4	R		7	10.2	R		3	8.4	R
	11	9.6	B		7	10.0	Hy		14	9.7	R		10	10.0	R		4	8.1	L
	12	9.6	R		7	11.0	R		15	9.6	R		11	10.2	R		4	8.5	R
	13	9.8	Pi		8	11.0	R		16	9.5	R		12	10.1	R		5	8.6	R
	13	9.6	R		8	11.2	Ly		17	9.6	R		13	10.3	R		6	8.6	R
	14	9.5	R		10	11.4	Pi		18	9.5	R		13	9.9	Hy		7	8.4	Hy
	14	9.8	O		10	11.4	R		28	9.6	R		14	10.0	Hy		7	8.7	R
	14	10.0	Ba		11	11.5	R	7	2	9.4	R		14	10.6	R		8	8.8	R
	15	9.7	R		12	11.1	E		3	9.6	R		15	9.9	Hy		8	8.3	Pi
	15	9.5	M		12	11.6	R		4	9.4	L		15	10.2	R		8	8.4	Ba
	16	9.7	R		13	11.6	R		5	9.5	R		16	9.9	Hy		10	8.7	R
	17	9.8	R		14	10.2	Hy		7	9.5	R		16	10.2	R		11	8.7	R
	18	9.7	R		14	12.7	R		8	9.2	Pi		16	11.1	E		12	8.8	R
	18	9.6	Ba		15	10.5	Hy		8	9.0	Ba		17	10.1	R		13	8.7	R
	19	9.8	R		15	11.6	R		8	9.5	R		18	10.0	Hy		14	8.8	R
	20	9.6	R		16	10.5	Hy		10	9.4	R		18	10.1	R		14	8.4	Hy
	22	9.8	R		17	11.7	Ly		11	8.9	L		20	10.0	Hy		15	8.8	R
	30	8.7	M		18	11.5	Ba		11	9.4	R		22	10.1	R		15	8.5	Hy

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

R U Librae

Mo.	Day	Est.	Obs.
7	16	8.6	Hy
	18	8.8	R
	18	8.5	Hy
	20	8.8	R
	22	9.0	R
	23	8.4	L
	27	9.1	R
	28	9.4	R
	30	9.5	R
	31	9.6	R
	31	8.4	L
8	6	9.8	R
	10	10.0	R
	11	9.4	L
	11	10.0	R
	12	10.2	R
	13	10.3	R
	14	10.4	R
	15	10.4	R
	16	9.6	B
	16	10.4	R
	19	10.7	R

153378

S Urs. Min.

Mo.	Day	Est.	Obs.
5	30	9.2	R
6	3	8.8	R
	4	8.6	R
	6	8.8	R
	7	9.0	R
	10	8.8	R
	11	9.0	L
	11	8.7	R
	12	8.7	R
	13	8.5	R
	14	8.5	R
	15	8.4	R
	16	8.4	R
	17	8.4	R
	18	8.5	R
	22	8.4	R
	23	8.4	R
	24	8.7	R
	25	8.6	R
	27	8.6	R
	28	8.6	R
7	2	8.7	R
	3	8.7	R
	4	8.7	R
	5	8.7	R
	6	8.6	Ba
	6	8.7	L
	7	8.5	R
	8	8.6	Ly
	8	8.5	R
	9	8.7	R
	10	8.6	R
	11	8.6	R
	12	8.6	R
	12	8.6	E

S Urs. Min.

Mo.	Day	Est.	Obs.
	12	8.5	Pi
7	13	8.7	R
	14	8.7	R
	15	8.7	R
	18	8.8	R
	18	8.6	Ba
	20	8.6	R
	22	8.7	R
	25	8.5	Ba
	25	8.2	Sp
	27	8.7	R
	28	8.6	R
	30	8.6	R
	31	8.8	R
8	6	8.8	R
	7	8.7	R
	9	8.6	Ba
	10	8.7	R
	11	8.7	R
	11	8.6	L
	12	8.6	R
	13	8.6	Pi
	13	8.6	R
	14	8.8	R
	15	9.0	R
	16	8.9	R
	17	8.9	R
	17	8.7	Ba
	18	9.0	R
	19	9.3	R
	20	8.7	R
	22	9.0	R
	24	8.8	B

154428

R Cor. Bor.

Mo.	Day	Est.	Obs.
5	30	6.1	R
6	3.7	6.3	R
	4.7	6.0	R
	6.7	6.0	R
	7.7	5.9	R
	10	6.0	L
	10.7	5.8	R
	10	6.2	Hy
	11	6.1	Hy
	11.7	5.7	R
	12	6.1	Hy
	12.7	5.6	R
	12.9	5.6	R
	13	6.0	Hy
	13.7	5.5	R
	14.7	5.4	R
	15.7	5.5	R
	16	6.0	L
	16.7	5.6	R
	17	6.0	Hy
	17.7	5.7	R

R Cor. Bor.

Mo.	Day	Est.	Obs.
6	18.7	5.7	R
	20	6.1	Hy
	22.9	5.8	R
	27.7	5.8	R
	28.7	5.8	R
	30.7	5.9	Mu
7	2.7	5.8	R
	3.7	5.6	R
	4.7	5.6	R
	5.7	5.5	R
	5.7	6.1	Mu
	6	5.9	L
	6.5	6.0	Pi
	6.7	6.2	Mu
	7	5.9	Hy
	7.7	5.6	R
	8.5	5.6	Ba
	8.5	6.0	Pi
	8.6	6.0	Ly
	8.7	5.4	R
	9.6	5.8	Ba
	9.7	6.0	Mu
	9.7	5.3	R
	10.5	6.0	Pi
	10.7	6.0	Mu
	10.7	5.3	R
	11	6.0	L
	11.6	6.0	Ma
	11.7	6.1	Mu
	11.7	5.3	R
	12.5	5.8	Ba
	12.6	6.1	E
	12.6	6.0	Pi
	12.7	6.1	Mu
	12.7	5.4	R
	13	6.0	L
	13.6	6.0	E
	13.6	6.1	Ma
	13.7	6.2	Mu
	13.7	5.4	R
	14	6.1	Hy
	14.5	5.8	Ba
	14.7	6.2	Mu
	14.7	5.4	R
	15	6.1	Hy
	15.7	6.1	Mu
	15.7	5.5	R
	16	6.1	Hy
	16.6	6.1	E
	16.7	6.0	Mu
	17.6	6.1	E
	17.6	6.0	Ly
	17.6	5.9	Ma
	17.7	6.1	Mu
	18	6.1	Hy
	18.6	5.9	Ba
	18.7	5.5	R
	20.6	6.1	E
	24.5	6.8	Ba
	24.5	6.8	MBa

R Cor. Bor.

Mo.	Day	Est.	Obs.
7	25.5	6.9	Ba
	28	7.1	L
	28.7	5.7	R
	28.7	6.1	Mu
	29.7	6.2	Mu
	30.7	7.2	Mu
	30.7	6.0	R
	31.7	6.8	R
8	1	7.2	L
	1.6	7.2	Ma
	1.7	7.5	Mu
	2.6	7.4	Ma
	2.7	7.6	Mu
	3.7	7.5	Mu
	4	7.5	L
	4.5	8.2	O
	4.7	7.7	Mu
	5.7	7.5	Mu
	6	7.6	L
	6.6	7.4	E
	6.7	7.1	R
	7	7.7	L
	7.5	7.7	Ba
	7.6	7.7	Ma
	7.7	7.6	R
	8	7.9	L
	8.5	8.2	Pi
	8.6	7.7	Ma
	9	7.8	L
	9.5	7.9	Ba
	9.5	8.1	O
	9.6	7.7	E
	9.7	8.0	R
	10.5	8.0	Ba
	10.5	7.9	O
	10.6	7.8	E
	10.7	6.1	R
	11	8.0	L
	11.5	8.2	Pi
	11.5	8.1	O
	11.6	7.9	E
	11.7	6.2	R
	12.7	7.4	R
	13.5	8.2	Pi
	13.5	8.0	Ma
	13.5	8.1	Ba
	13.7	8.1	R
	14.5	8.2	Ba
	14.5	8.4	O
	14.6	8.1	Ma
	14.7	8.6	R
	15.6	7.9	M
	15.6	8.2	Ma
	15.7	8.7	R
	16.5	8.2	Ba
	16.5	8.6	O
	16.6	8.0	M
	16.7	9.0	R
	17.5	8.7	O
	17.5	8.3	Ba

R Cor. Bor.

Mo.	Day	Est.	Obs.
8	17.6	8.5	E
	17.6	8.1	M
	17.7	9.2	R
	18.5	8.3	Ba
	18.6	8.5	E
	18.6	8.1	Ma
	18.7	9.3	R
	19.6	8.0	B
	19.7	9.4	R
	20.6	8.4	B
	20.7	9.4	R
	21.6	8.4	E
	22.7	8.7	R
	23.5	8.2	Ba
	23.6	8.3	E
	24.3	8.3	B
	24.6	8.3	M
	25.5	8.2	B
	25.5	8.4	M
	25.6	8.2	E
	26.5	8.1	B
	27.5	8.1	B
	30.5	8.1	B
	30.5	8.2	Ba
	30.6	8.5	M
	30	7.8	V
9	6	7.6	O

154536

X Cor. Bor.

Mo.	Day	Est.	Obs.
8	10	12.8	B
	17	12.5	Ba

154639

V Cor. Bor.

Mo.	Day	Est.	Obs.
7	9	10.3	Ba
	16	10.7	E
	18	10.4	Ba
8	10	10.5	Ba
	17	10.4	M
	17	10.0	Ba

154615

R Serpentis

Mo.	Day	Est.	Obs.
5	30	8.3	R
6	3	8.3	R
	4	8.5	R
	6	8.5	R
	7	8.7	R
	10	8.9	R
	11	8.4	Hy
	11	8.9	R
	12	8.2	Hy
	12	8.7	R
	13	8.3	Hy
	13	9.0	R
	14	8.9	R
	15	8.8	R
	16	8.8	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

R Serpentis 160210

Mo.	Day	Est.	Obs.
6	17	8.5	Hy
	17	8.7	R
	18	8.3	R
	20	8.6	Hy
	22	8.9	R
	23	9.3	R
	24	9.4	R
	25	9.4	R
	26	9.4	R
	27	9.4	R
	28	9.5	R
7	1	9.2	Ly
	2	9.7	R
	3	9.5	R
	4	9.6	R
	5	9.4	R
	6	9.3	Ba
	7	9.2	Hy
	7	9.7	R
	8	9.2	Pi
	8	9.8	R
	9	9.7	R
	10	9.7	R
	11	9.8	R
	12	9.7	R
	13	9.5	E
	13	9.7	R
	14	9.4	Hy
	14	9.9	R
	15	10.1	R
	15	9.8	Hy
	16	9.7	Hy
	17	9.7	Pi
	18	10.0	Hy
	18	10.0	Ba
	18	10.4	R
	20	10.6	R
	21	9.8	Ly
	25	10.3	Ba
	27	10.6	R
	28	10.6	R
	29	10.3	B
	30	10.8	R
	31	10.9	R
8	6	11.0	R
	10	11.0	Ba
	10	11.1	R
	12	11.3	R
	13	11.3	R
	14	11.4	R
	17	11.2	Ba

155823

RZ Scorpii

6	16	11.8	L
8	7	11.7	L

155847

X Herculis

8	13	7.0	Pi
	18	6.5	Ba

U Serpentis

Mo.	Day	Est.	Obs.
7	6	8.1	Ba
	12	8.4	Ba
	16	8.5	E
	18	8.5	Ba
	25	8.9	Ba
	29	8.7	B
8	9	9.3	Ba
	14	10.0	O
	17	9.4	Ba

160625

RU Herculis

7	3	10.7	V
	6	11.5	Ba
	17	10.8	V
	18	11.6	Ba
8	10	11.9	Ba
	17	11.9	Ba
	17	12.0	M

161138

W Cor. Bor.

7	8	11.9	Ba
	17	11.5	E
	18	12.4	Ba

162112

V Ophiuchi

5	25	8.0	L
6	17	8.7	R
	18	8.5	R
	27	8.3	R
	28	8.3	R
7	2	8.3	R
	3	8.2	R
	4	8.1	R
	5	8.4	R
	7	8.2	R
	8	8.3	R
	9	8.5	R
	9	8.1	L
	10	8.2	R
	11	8.5	R
	12	8.5	R
	13	8.4	R
	14	8.5	R
	15	8.7	R
	18	8.8	R
	20	8.9	R
	27	8.9	R
	28	8.8	R
	30	9.0	R
	31	9.1	R
8	6	9.1	R
	7	8.6	L
	7	9.3	R
	10	8.1	Ba
	10	9.5	R
	11	9.4	R
	12	9.5	R
	13	9.5	R

V Ophiuchi

Mo.	Day	Est.	Obs.
8	14	9.5	R
	15	9.4	R
	16	9.1	R
	17	9.0	R
	17	8.5	Ba
	18	9.0	R
	19	8.9	R
	20	8.8	R
	22	8.9	R

162119

U Herculis

5	30	7.4	R
6	3	8.0	R
	4	8.5	R
	6	8.4	R
	7	7.8	Hy
	7	8.5	R
	10	8.5	R
	10	8.2	Hy
	11	9.0	Ma
	11	8.6	R
	11	8.1	Hy
	12	8.6	R
	12	8.0	Hy
	13	8.4	R
	13	8.1	Hy
	14	8.4	R
	15	8.3	R
	16	8.3	R
	17	9.2	Ma
	17	8.3	R
	18	8.5	R
	20	8.5	Hy
	22	8.5	R
	23	8.6	R
	24	8.8	R
	25	8.9	R
	26	8.8	R
	27	8.8	R
	27	9.1	M
	28	8.7	R
7	2	8.8	R
	3	8.7	R
	4	8.7	R
	5	8.6	R
	6	8.6	R
	6	9.0	Ba
	9	8.5	R
	7	9.3	Hy
	8	9.1	Ly
	8	9.6	R
	9	8.5	R
	10	8.5	R
	11	8.7	R
	12	8.7	R
	12	9.1	Ba
	13	8.7	R
	14	8.7	R
	14	9.0	Hy

U Herculis

Mo.	Day	Est.	Obs.
7	15	9.2	Hy
	15	8.7	R
	16	9.3	E
	16	9.1	Hy
	17	9.3	Pi
	18	8.6	R
	18	9.1	Ba
	18	9.2	Hy
	19	9.5	M
	20	8.6	R
	21	9.4	Ly
	25	9.3	Ba
	27	8.8	R
	28	8.8	R
	30	9.4	R
	31	9.4	R
8	6	9.5	R
	7	9.5	Ma
	7	9.8	R
	9	9.8	R
	9	9.8	O
	9	9.8	Ba
	10	10.0	R
	11	9.9	R
	12	9.9	R
	13	10.0	R
	14	10.1	R
	14	9.8	O
	15	10.2	R
	16	10.1	R
	17	10.0	M
	17	10.2	R
	17	9.6	Ba
	18	10.2	R
	18	9.9	Ba
	19	10.1	R
	20	10.3	R
	22	10.3	R

162807

SS Herculis

7	4	11.8	L
	6	11.7	Ba
	8	11.8	L
	9	11.2	Ba
	17	10.1	V
	17	10.9	E
	18	10.3	Ba
	23	9.9	L
	24	9.7	Ba
	30	9.2	V
	31	9.3	L
8	4	9.2	L
	6	9.3	V
	9	9.3	Ba
	13	9.1	Ba
	14	9.3	V
	17	9.2	Ba
	28	9.9	V

163137

W Herculis

Mo.	Day	Est.	Obs.
6	27	8.6	M
7	6	8.4	Ba
	16	8.7	Pi
	18	8.5	Ba
	25	8.6	Ba
8	9	9.3	Ba
	15	9.8	M
	17	9.4	Ba
	30	10.3	M

163172

R Urs. Min.

6	3	9.5	R
	4	9.4	R
	6	9.5	R
	7	9.5	R
	10	9.5	R
	11	9.5	R
	12	9.4	R
	13	9.5	R
	14	9.5	R
	15	9.6	R
	16	9.7	R
	17	9.7	R
	18	9.7	R
	22	9.4	R
	23	9.6	R
	24	9.8	R
	25	9.5	R
	26	9.7	R
	27	9.8	R
	28	9.8	R
7	2	10.0	R
	3	9.9	R
	4	9.6	R
	6	9.6	R
	7	9.7	R
	8	9.8	R
	9	10.3	R
	9	9.5	Ba
	9	9.4	MBa
	10	9.9	R
	11	10.0	R
	12	10.0	R
	12	10.0	Pi
	13	10.1	R
	14	10.1	R
	15	10.0	R
	16	10.0	E
	17	10.4	Ly
	18	9.8	R
	18	9.4	Ba
	20	9.8	R
	22	9.9	R
	25	9.5	Ba
	27	9.9	R
	28	10.0	R
	30	10.0	R
	31	9.9	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

R Urs. Min.

Mo.	Day	Est.	Obs.
8	6	10.0	R
	7	10.1	R
	9	9.5	Ba
	10	9.7	R
	11	10.1	R
	12	9.9	R
	13	10.0	Pi
	13	9.8	R
	14	9.6	R
	15	9.5	R
	15	10.0	M
	16	9.7	R
	17	9.6	R
	17	9.3	Ba
	18	9.8	R
	19	10.0	R
	20	10.1	R
	22	10.1	R
	25	9.4	B

163266

R Draconis

Mo.	Day	Est.	Obs.
6	26	8.8	M
7	6	8.0	Ba
	7	7.6	R
	8	8.1	Ly
	8	7.7	R
	9	7.5	R
	10	7.9	M
	10	7.4	R
	11	7.3	R
	12	7.2	R
	12	7.5	Ba
	12	8.0	Ly
	13	7.1	R
	14	7.0	R
	15	7.0	R
	16	7.4	E
	17	7.3	Ma
	18	7.1	R
	18	7.4	Ba
	20	7.0	R
	22	7.0	R
	24	7.2	Ba
	24	6.8	MBa
	24	7.2	Sp
	25	7.1	Sp
	27	7.0	R
	28	7.1	R
	29	7.0	Sp
	30	7.2	R
	31	7.3	R
8	2	7.3	Ma
	6	7.4	R
	7	7.5	R
	9	7.7	O
	9	7.3	Ba
	10	7.5	Sp
	10	7.8	R
	11	7.8	R

R Draconis

Mo.	Day	Est.	Obs.
8	12	7.9	R
	13	7.9	R
	14	7.3	Ba
	14	7.4	Ma
	14	7.9	R
	15	7.9	R
	15	7.7	M
	16	7.8	R
	17	7.4	Ba
	17	7.4	E
	17	7.7	R
	18	7.6	R
	19	7.6	R
	20	7.5	R
	22	7.6	R
	30	7.8	B
9	7	8.4	O

164055

S Draconis

Mo.	Day	Est.	Obs.
6	11	8.3	Hy
	12	8.1	Hy
	13	8.0	Hy
	16	9.4	R
	17	9.1	R
	17	8.1	Hy
	18	9.0	R
	20	8.3	Hy
	23	9.0	R
	24	9.0	R
	25	9.0	R
	26	8.9	R
	27	9.1	R
	28	9.2	R
7	2	9.4	R
	3	9.1	R
	4	9.3	R
	5	9.1	R
	7	9.2	R
	7	8.0	Hy
	8	9.0	R
	9	8.8	R
	10	8.8	R
	11	8.8	R
	12	8.7	R
	13	8.7	R
	14	8.8	R
	14	8.2	M
	14	8.2	Hy
	15	8.5	R
	15	8.7	Hy
	16	8.4	Hy
	18	8.2	Hy
	18	8.8	R
	20	8.5	R
	22	8.6	R
	27	8.7	R
	28	8.8	R
	30	8.7	R
	31	8.9	R

S Draconis

Mo.	Day	Est.	Obs.
8	4	8.7	M
	6	9.0	R
	7	9.1	R
	10	8.7	R
	11	8.8	R
	12	8.8	R
	13	8.5	R
	14	8.6	R
	15	8.3	R
	15	8.9	M
	16	8.2	R
	17	8.1	R
	18	8.2	R
	19	8.0	R
	20	8.1	R

164715

S Herculis

Mo.	Day	Est.	Obs.
6	4	8.4	R
	6	8.5	R
	7	8.4	R
	10	8.4	R
	11	8.5	R
	12	8.5	R
	13	8.5	R
	14	8.5	R
	15	8.4	R
	16	8.5	R
	17	8.5	R
	18	8.4	R
	22	8.6	R
	23	8.3	R
	24	8.3	R
	25	8.5	R
	26	8.3	R
	27	8.4	R
	28	8.4	R
7	2	8.5	R
	3	8.6	R
	4	8.8	R
	5	8.6	R
	6	8.0	Ba
	7	8.7	R
	8	8.7	R
	8	8.2	Ly
	9	8.5	R
	10	8.6	R
	11	8.4	Ma
	11	8.7	R
	12	8.8	E
	12	8.8	R
	13	8.9	R
	14	8.9	R
	15	9.0	R
	17	8.4	Ly
	17	8.5	Pi
	17	8.5	Ma

S Herculis

Mo.	Day	Est.	Obs.
7	18	8.7	R
	20	9.1	R
	22	9.2	R
	25	8.6	Ba
	27	9.6	R
	28	9.6	R
	30	9.7	R
	31	9.8	R
8	1	8.8	Ma
	6	10.0	R
	7	10.0	R
	9	9.5	Ba
	9	9.6	O
	9	10.0	R
	11	10.0	R
	12	9.9	R
	13	10.0	R
	14	10.1	O
	14	10.0	R
	15	10.0	R
	15	10.2	M
	16	10.1	R
	17	9.5	Ba
	17	10.1	R
	18	10.1	R
	19	10.2	R
	20	10.2	R
	22	10.2	R

164319

RR Ophiuchi

Mo.	Day	Est.	Obs.
7	8	11.2	Ba

165030

RR Scorpii

Mo.	Day	Est.	Obs.
6	15	9.8	R
	16	10.3	R
	17	10.3	R
	18	10.2	R
7	2	10.5	R
	5	10.8	R
	7	11.0	R
	8	10.8	R
	8	11.0	Pi
	10	11.0	R
	11	11.1	R
	12	11.2	R
	13	11.3	R
	14	11.7	R
	15	11.2	R
	18	11.3	R

165631

RV Herculis

Mo.	Day	Est.	Obs.
7	6	13.3	Ba
	12	12.4	L
	19	11.4	M
8	10	11.1	Ba
	11	11.4	E
	14	11.0	M

RV Herculis

Mo.	Day	Est.	Obs.
8	17	11.6	L
	17	11.4	E
	17	11.4	Ba
	18	11.2	Ba

170215

R Ophiuchi

Mo.	Day	Est.	Obs.
5	25	8.8	L
6	6	8.4	R
	7	8.4	R
	7	8.2	Hy
	10	8.3	R
	10	8.2	Hy
	11	8.3	R
	11	8.1	Hy
	12	8.3	R
	12	8.2	Hy
	13	8.3	R
	13	8.1	Hy
	14	8.2	R
	15	8.1	R
	16	7.8	L
	16	8.0	R
	17	8.0	R
	18	8.0	R
	20	8.0	Hy
	22	7.8	R
	23	7.8	R
	24	7.7	R
	25	7.6	R
	26	7.9	R
	27	8.0	R
7	1	8.0	Ly
	2	8.3	R
	3	8.4	R
	4	8.4	R
	5	8.4	R
	6	8.4	R
	7	7.8	L
	7	8.1	Hy
	7	8.4	R
	8	8.0	Ba
	8	8.4	R
	9	8.5	R
	10	8.5	R
	11	8.5	R
	12	8.5	R
	13	8.5	R
	14	8.5	R
	14	8.0	Hy
	14	8.0	Pi
	15	8.5	R
	15	8.0	Hy
	16	8.0	Hy
	17	7.9	Ly
	18	8.1	Hy
	18	8.5	R
	20	8.5	R
	22	8.5	R
	24	8.3	Ba

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

R Ophiuchi

Mo.	Day	Est.	Obs.
7	27	8.9	R
	28	8.9	R
	30	8.9	R
	31	9.1	R
8	1	8.7	L
	6	9.2	R
	7	9.1	R
	9	9.4	R
	10	9.3	Ba
	10	9.4	R
	11	9.2	Pi
	11	9.3	R
	12	9.3	R
	13	9.3	R
	14	9.4	R
	15	9.5	R
	16	9.4	R
	17	9.6	R
	17	9.4	Ba

170627
RT Herculis

Mo.	Day	Est.	Obs.
7	8	9.1	Ba
	24	9.2	Ba
8	10	9.9	Ba
	17	9.7	Ba

171333
***u* Herculis**

Mo.	Day	Est.	Obs.
5	30.7	5.2	R
6	3.7	4.7	R
	4.7	4.5	R
	6.7	4.6	R
	7.7	4.5	R
	10.7	4.9	R
	11.7	4.7	R
	12.7	4.6	R
	12.7	4.6	R
	12.9	4.7	R
	13.7	4.8	R
	14.7	4.7	R
	15.7	4.9	R
	16.7	4.7	R
	17.7	4.6	R
	18.7	4.5	R
	22.9	4.6	R
	23.7	4.8	R
	24.7	4.7	R
	25.7	4.7	R
	26.7	4.8	R
	27.7	4.5	R
	28.7	4.6	R
7	2.7	4.6	R
	3.7	4.8	R
	4.7	4.5	R
	5.7	4.4	R
	5.9	4.6	R
	7.7	5.0	R
	7.9	4.7	R
	8.7	5.2	R

***u* Herculis**

Mo.	Day	Est.	Obs.
7	9.7	4.7	R
	10.7	5.1	R
	11.7	4.6	R
	11.9	4.9	R
	12.7	5.0	R
	13.7	4.7	R
	14.7	5.1	R
	15.7	4.6	R
	18.7	4.8	R
	20.7	4.7	R
	22.7	4.8	R
	27.7	4.7	R
	28.7	4.6	R
	30.7	4.4	R
	31.7	4.6	R
8	6.7	4.7	R
	9.7	4.6	R
	10.7	4.6	R
	11.7	4.6	R
	12.7	5.1	R
	13.7	4.9	R
	14.7	5.0	R
	15.7	4.9	R
	16.7	5.4	R
	17.7	4.7	R
	18.7	5.4	R
	19.7	4.6	R
	20.7	5.5	R
	22.7	5.1	R

171401
Z Ophiuchi

Mo.	Day	Est.	Obs.
7	3	8.4	V
	8	8.6	Ba
	11	9.0	V
	17	9.2	E
	17	9.0	V
	24	9.1	Ba
	30	9.1	V
8	6	9.5	V
	10	9.6	Ba
	14	9.9	V
	17	9.6	Ba
	29	9.4	V

171723
RS Herculis

Mo.	Day	Est.	Obs.
6	16	12.0	L
7	1	12.3	Ly
	8	12.5	Ba
8	10	12.0	Ba
	17	10.6	Ba
	29	9.7	V

172808
RU Ophiuchi

Mo.	Day	Est.	Obs.
7	8	13.5	Ba
8	11	13.1	B

175458
T Draconis

Mo.	Day	Est.	Obs.
6	7	9.1	R
	10	9.4	R
	11	9.4	R
	12	9.3	R
	14	9.5	R
	15	9.4	R
	16	9.5	R
	17	9.3	R
	18	9.3	R
	22	9.5	R
	27	9.3	R
	28	9.6	R
7	2	9.4	R
	3	9.3	R
	4	9.2	R
	5	9.2	R
	7	9.1	R
	8	9.0	R
	9	9.0	R
	10	9.2	R
	11	9.3	R
	12	9.0	R
	13	9.3	R
	14	9.3	R
	14	10.2	M
	15	9.1	R
	18	9.3	R
	20	9.5	R
	22	9.4	R
	25	10.5	Ba
	27	9.4	R
	28	9.2	R
	30	9.3	R
	31	9.6	R
8	4	10.1	M
	6	9.1	R
	7	9.0	R
	10	9.3	R
	10	10.5	Ba
	11	9.7	R
	12	9.2	R
	13	9.4	R
	14	9.6	R
	15	9.6	R
	16	9.7	R
	17	10.5	Ba
	17	9.6	R
	18	9.5	R
	19	9.6	R
	20	9.7	R
	30	10.2	V

175519
RY Herculis

Mo.	Day	Est.	Obs.
7	9	10.2	Ba
	17	10.8	E
	24	10.9	Ba
8	10	12.8	Ba

180531
T Herculis

Mo.	Day	Est.	Obs.
6	12	10.1	Hy
	13	10.1	Hy
	20	10.2	Hy
	27	11.5	M
7	4	11.3	R
	5	11.3	R
	7	11.0	R
	8	10.9	R
	9	11.0	R
	10	10.8	R
	11	10.8	R
	12	10.7	R
	13	10,3	R
	14	10.2	R
	15	9.7	R
	17	9.3	Pi
	18	10.1	R
	20	9.6	R
	22	9.5	R
	27	9.2	R
	28	9.1	R
	30	9.1	R
	31	8.9	R
8	6	8.8	R
	7	8.4	Ma
	7	8.7	R
	10	8.5	R
	11	8.5	R
	12	8.6	R
	13	8.6	R
	13	8.4	Pi
	14	8.3	Ba
	14	8.3	Ma
	14	8.6	R
	15	8.6	M
	15	8.5	R
	16	8.5	R
	17	8.6	R
	18	8.6	R
	19	8.7	R
	20	8.4	R
	22	8.2	R

181103
RV Ophiuchi

Mo.	Day	Est.	Obs.
7	3	8.5	V
	11	8.9	V
	17	9.1	V
8	10	12.0	Ba
	17	12.0	Ba

181136
W Lyrae

Mo.	Day	Est.	Obs.
6	6	10.2	R
	7	9.8	Hy
	7	9.9	R
	10	9.9	R
	10	10.1	Hy
	11	9.8	R
	11	10.0	Hy

W Lyrae

Mo.	Day	Est.	Obs.
6	12	9.8	R
	12	10.1	Hy
	13	9.8	R
	13	10.2	Hy
	14	9.8	R
	15	9.7	R
	16	9.6	R
	17	9.6	R
	18	9.5	R
	20	10.0	Hy
	22	9.6	R
	23	9.6	R
	24	9.5	R
	25	9.5	R
	26	9.4	R
	27	9.4	R
	28	8.4	R
7	2	9.4	R
	3	9.5	R
	4	9.4	R
	4	9.6	M
	5	9.4	R
	7	9.4	R
8	7	9.8	Hy
	8	9.3	R
	9	9.6	Ba
	9	9.3	R
	10	9.2	R
	11	9.2	R
	12	9.1	R
	13	9.2	R
	14	9.2	R
	14	9.7	Hy
	15	9.2	R
	15	9.9	Hy
	16	9.7	Hy
	18	9.4	Hy
	18	9.1	R
	20	9.1	R
	22	9.0	R
	24	8.6	Ba
	27	8.6	R
	28	8.6	R
	30	8.6	R
	31	8,5	R
8	6	8.4	R
	7	8.6	R
	9	8.1	Ba
	9	8.2	M
	10	8.6	R
	11	8.7	R
	12	8.7	R
	13	8.8	R
	14	8.3	Ma
	14	8.3	Ba
	14	8.7	R
	15	8.5	R
	16	8.6	Sp
	16	8.4	R
	17	8.5	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

W Lyrae				X Ophiuchi				R Scuti				R Scuti				β Lyrae			
Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.
8	18	8.2	Ba	8	7	8.3	R	7	11.9	5.3	R	8	16.7	5.4	R	7	22.7	3.9	R
	18	8.5	R		10	8.3	R		12.5	5.3	Ba		16.7	5.8	Mu		27.7	4.0	R
	19	8.8	R		10	7.6	Ba		12.6	5.2	Pi		17	5.3	L		28.7	3.9	R
	20	8.7	R		10	7.7	O		12.7	5.3	R		17.5	5.4	Ba		30.7	3.7	R
	22	8.6	R		11	8.3	R		13	5.2	L		17.5	5.8	O		31.7	3.4	R
	25	8.7	E		12	8.2	R		13	5.3	Ma		17.6	5.2	Pi	8	6.7	3.5	R
	30	8.5	M		13	8.1	R		13.7	5.4	R		17.7	5.7	R		7.7	3.7	R
					14	7.5	Ma		14.5	5.3	Ba		18	5.5	Ma		8.7	3.7	R
	182306				14	7.7	V		14.6	5.2	Pi		18.5	5.5	Ba		9.7	3.6	R
T Serpentis					14	8.2	R		14.7	5.6	R		18.7	5.3	R		10.7	3.9	R
6	12	9.8	Hy		15	8.1	R		15.7	5.5	R		19.7	5.5	R		10.9	3.6	R
	13	9.9	Hy		16	8.1	R		16.7	5.4	Pi		20.7	5.4	R		11.7	3.4	R
	20	9.9	Hy		16	7.5	Ba		17	5.1	Ma		22.7	5.3	R		12.7	3.5	R
7	10	10.6	R		17	8.0	R		17.6	5.1	Ly		23.5	5.3	Ba		13.7	3.5	R
	12	10.6	R		17	7.4	M		18.6	5.2	Ba		30.5	5.4	Ba		14.7	3.7	R
	13	10.7	R		18	7.3	Ma		18.7	5.9	R	9	7.5	5.8	O		15.7	3.9	R
	14	10.7	R		18	8.2	R		20.7	5.9	R						16.7	4.1	R
	15	10.7	R		19	8.1	R		22.7	6.1	R		184633				17.7	3.6	R
	18	10.7	R		20	8.2	R		24.5	5.2	Ba		β Lyrae				17.9	3.5	R
	28	10.7	R		22	7.9	R		25.5	5.3	Ba	5	30.7	3.8	R		18.7	3.7	R
	30	10.8	R		30	6.9	V		27.7	5.9	R	6	3.7	3.6	R		18.9	3.5	R
	31	10.9	R						28.7	5.7	R		4.7	3.9	R		19.7	3.4	R
8	6	11.0	R		*184205*				30.7	5.6	R		6.7	3.9	R		20.7	3.6	R
	10	11.6	Ba		R Scuti				31.7	5.4	R		7.7	3.5	R		22.7	4.3	R
	10	11.6	R	6	11	5.5	L		31	5.4	L		10.7	3.7	R				
	11	11.6	R		11	5.8	Hy	8	1	5.5	Ma		11.7	3.8	R		185243		
	12	11.6	R		13	5.9	Hy		2.7	5.9	Mu		12.7	3.7	R		R Lyrae		
	17	11.8	Ba		12.9	6.0	R		3.7	5.9	Mu		12.9	3.8	R	6	3	4.2	R
	17	7.7	M		12	6.0	Hy		4.5	5.7	O		13.7	3.7	R		4	4.4	R
					14.7	5.7	R		4.7	6.1	Mu		14.7	3.5	R		6	4.1	R
	183308				15.7	5.6	R		6.7	5.7	R		15.7	3.7	R		7	4.1	R
X Ophiuchi					16	5.4	L		7	5.5	Ma		16.7	3.6	R		10	4.1	R
6	16	8.5	L		16.7	5.4	R		7.5	5.3	Ba		17.7	3.7	R		11	4.1	R
7	3	7.7	V		17.7	5.3	R		7.7	5.4	R		18.7	3.8	R		12	4.2	R
	8	8.0	L		18.7	5.4	R		8	5.6	Ma		22.9	3.4	R		13	4.3	R
	9	8.0	Ba		20	5.6	Hy		8.7	5.5	Mu		23.7	3.5	R		14	4.3	R
	10	8.2	R		22.9	4.8	R		9	5.0	L		24.7	3.9	R		15	4.4	R
	11	7.8	Ma		23.7	4.9	R		9.5	5.8	O		25.7	4.1	R		16	4.4	R
	11	7.8	V		24.7	4.8	R		9.6	5.5	Ba		26.7	3.6	R		17	4.5	R
	11	8.4	R		25.7	4.8	R		9.7	5.3	Mu		27.7	3.8	R		18	4.3	R
	12	8.2	R		27.7	4.8	R		10.5	5.8	O		28.7	3.7	R		22	4.2	R
	13	8.1	R	7	1.6	5.2	Ly		10.5	5.4	Ba	7	2.7	3.7	R		23	4.1	R
	14	8.0	R		2.7	4.7	R		10.7	5.0	R		3.7	3.4	R		24	4.0	R
	15	8.0	R		3.7	4.6	R		10.7	5.3	Mu		4.7	3.8	R		25	4.1	R
	17	7.5	M		4.7	4.6	R		11	5.2	L		5.7	3.9	R		26	4.2	R
	17	7.7	V		5.7	4.4	R		11.5	5.7	O		5.9	3.4	R		27	4.1	R
	18	8.1	R		6	5.2	L		11.6	5.0	Pi		6.7	3.9	R		28	4.0	R
	20	8.0	R		6.6	5.2	Pi		11.7	4.9	R		7.7	3.9	R	7	2	4.1	R
	22	7.9	R		6.6	5.3	Ba		13	5.6	Ma		7.9	4.2	R		3	4.1	R
	24	7.6	Ba		7.7	4.8	R		13.5	5.4	Ba		8.7	4.0	R		4	4.2	R
	27	8.0	R		7.9	4.9	R		13.6	5.2	Pi		9.7	4.1	R		5	4.1	R
	28	8.0	R		8.5	5.2	Ba		13.7	4.9	R		10.7	4.0	R		3	4.0	R
	30	7.5	M		8.5	5.2	Pi		14	5.6	Ma		11.7	3.6	R		8	4.2	R
	30	8.1	R		8.7	5.3	R		14.5	5.3	Ba		11.9	3.6	R		9	4.4	R
	31	7.7	V		9	5.2	L		14.5	5.7	O		12.7	3.8	R		10	3.9	R
	31	7.7	L		9.5	5.2	Ba		14.7	5.1	R		13.7	3.7	R		11	3.9	R
	31	8.1	R		9.7	5.4	R		15	5.5	Ma		14.7	3.9	R		12	4.0	R
8	6	7.1	V		10.5	5.2	Pi		15.7	5.3	R		15.7	4.0	R		13	3.9	R
	6	8.0	R		10.7	5.2	R		16.5	5.7	O		18.7	3.7	R		14	4.4	R
	7	7.5	Ma		11.7	5.3	R		16.5	5.5	Ba		20.7	4.0	R		15	4.4	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

R Lyrae

Mo.	Day	Est.	Obs.
7	18	4.3	R
	20	4.2	R
	22	4.3	R
	27	4.2	R
	28	4.4	R
	30	4.4	R
	31	4.3	R
8	6	4.1	R
	7	3.9	R
	10	4.3	R
	11	4.2	R
	12	4.2	R
	13	4.1	R
	14	4.1	R
	15	4.1	R
	16	4.1	R
	17	4.2	R
	18	4.1	R
	19	4.1	R
	20	4.0	R
	22	4.1	R

185995
V Aquilae

8	4	6.7	M

190108
R Aquilae

6	16	11.4	L
	26	9.9	E
7	6	10.8	Sp
	8	10.8	L
	12	10.5	Ba
	16	10.1	E
	18	9.4	Sp
	25	9.3	Ba
	31	9.6	L
8	11	7.9	B
	11	8.4	O
	13	7.5	Ba
	16	7.6	M
	17	7.5	Pi

190529
V Lyrae

7	8	12.4	L
8	7	11.7	L

190926
X Lyrae

6	3	9.3	R
	4	9.2	R
	6	9.1	R
	7	9.0	R
	10	9.1	R
	11	9.0	R
	12	9.0	Hy
	12	9.0	R
	13	9.0	R
	13	9.1	Hy
	14	9.0	R
	15	9.1	R

X Lyrae

Mo.	Day	Est.	Obs.
6	16	9.1	R
	17	9.1	R
	18	9.2	R
	20	8.7	Hy
	23	9.1	R
	24	9.1	R
	25	9.1	R
	26	9.0	R
	27	9.2	R
7	1	9.1	Ly
	2	9.3	R
	3	9.3	R
	4	9.4	R
	4	8.6	M
	5	9.5	R
	7	9.9	R
	8	9.9	R
	9	9.6	R
	10	9.7	R
	11	9.6	R
	12	9.6	R
	12	9.4	Ba
	13	9.6	R
	14	9.7	R
	15	9.7	R
	16	9.3	E
	17	9.1	M
	18	9.3	R
	20	9.3	R
	22	9.4	R
	27	9.6	R
	28	9.5	R
	30	9.6	R
	31	9.2	R
8	6	9.6	R
	7	9.6	R
	9	9.3	M
	10	9.4	R
	11	9.8	R
	12	9.8	R
	13	9.8	R
	13	9.3	Ba
	14	9.8	R
	15	9.7	R
	16	9.7	R
	17	9.6	R
	18	9.7	R
	19	9.7	R
	20	9.5	R
	22	9.7	R
	30	9.5	M

191019
R Sagittarii

5	25	11.2	L
8	13	10.0	Ba

191033
RY Sagittarii

8	10	6.7	R
	11	6.4	R
	12	6.5	R
	13	6.0	Ba

RY Sagittarii

Mo.	Day	Est	Obs.
8	13	6.5	R
	14	6.3	R
	15	6.6	R
	16	6.6	R
	17	6.7	R
	18	6.6	R
	19	6.7	R

191637
U Lyrae

7	12	10.7	Ba
8	9	11.0	Ba
	17	10.9	Ba

192928
TY Cygni

6	27	11.0	M
7	3	11.2	Bu
	4	11.4	M
	12	11.5	Ba
	24	12.2	Ba
8	4	12.0	M
	13	12.5	Ba

193311
RT Aquilae

6	16	9.1	L
7	8	8.8	L
	12	8.4	Ba
	24	8.4	Ba
8	1	9.5	L
	11	9.6	O
	13	9.6	Ba
9	7	10.8	O

193449
R Cygni

5	30	7.3	R
6	3	7.2	R
	4	7.1	R
	6	7.2	R
	7	7.2	R
	10	7.2	R
	11	7.1	R
	12	7.2	R
	13	7.2	R
	14	7.2	R
	15	7.2	R
	16	7.2	R
	17	7.2	R
	18	7.2	R
	23	8.5	R
	24	8.4	R
	25	8.4	R
	26	8.7	R
	27	8.7	R
7	2	8.9	R
	3	7.2	Bu
	3	8.8	R
	4	8.5	M
	4	8.8	R
	5	8.9	R

R Cygni

Mo.	Day	Est.	Obs.
7	7	8.9	R
	8	9.0	R
	8	7.1	Ly
	9	9.0	R
	9	7.8	Ba
	10	9.0	R
	11	9.0	R
	12	9.0	R
	13	9.1	R
	14	9.0	R
	15	9.1	R
	17	8.4	Ma
	17	7.2	Ly
	18	9.1	R
	19	8.8	M
	20	9.1	R
	22	9.1	R
	24	7.8	Ma
	25	8.9	M
	27	9.1	R
	28	9.2	R
	30	9.3	R
	31	9.2	R
	31	9.0	Pi
8	6	9.5	R
	7	9.1	Ma
	7	9.6	R
	9	8.8	Ba
	10	9.7	R
	11	9.8	R
	11	9.0	B
	12	9.8	R
	13	9.9	R
	13	8.9	Ba
	14	9.5	Ma
	14	10.0	R
	15	9.5	M
	15	10.1	R
	16	8.9	Sp
	16	10.2	R
	17	9.0	Sp
	17	10.3	R
	18	9.0	Ba
	18	10.5	R
	19	10.4	R
	20	10.4	R
	22	10.6	R
	30	9.7	M

193509
RV Aquilae

7	24	12.7	Ba
8	13	10.8	Ba
9	7	9.6	O

193732
TT Cygni

5	25	9.8	L
6	4	8.2	R
	6	8.2	R
	7	7.5	Hy

TT Cygni

Mo.	Day	Est.	Obs.
6	7	8.2	R
	10	7.8	Hy
	10	7.9	R
	11	7.8	R
	11	7.9	Hy
	12	7.8	R
	12	8.0	Hy
	13	8.0	R
	13	7.8	Hy
	14	7.9	R
	15	7.9	R
	16	7.9	R
	17	7.7	R
	18	7.7	R
	20	7.9	Hy
	23	7.9	R
	24	7.9	R
	25	8.0	R
	26	7.7	R
	27	8.0	R
	28	7.9	R
7	2	7.9	R
	3	8.8	Bu
	4	7.9	R
	5	8.1	R
	6	8.0	R
	6	8.3	Pi
	6	7.7	L
	8	7.7	R
	9	8.2	R
	10	7.8	R
	11	7.8	R
	12	7.7	R
	12	7.5	B
	13	7.7	R
	14	8.0	R
	15	7.8	R
	17	8.5	Ly
	17	8.4	Ma
	18	7.7	R
	20	8.0	R
	22	8.1	R
	22	8.2	M
	23	8.0	B
	24	7.8	Ba
	27	8.0	R
	28	8.2	R
	30	8.3	R
	30	8.5	Ly
	31	8.1	R
8	5	7.6	L
	6	8.2	R
	7	8.6	R
	8	8.2	Ma
	10	8.1	R
	11	8.1	R
	12	7.9	R
	13	7.8	Ba
	13	7.9	R
	14	7.7	R
	15	8.1	R
	15	8.6	M

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

TT Cygni				X Aquilae				η Aquilae				S Sagittae				SV Cygni			
Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.
8	15	7.9	R	7	4	10.5	R	8	7.7	4.4	R	8	5.7	6.0	Mu	6	10	9.8	R
	16	7.9	R		5	10.6	R		8.7	4.0	R		6.7	6.0	R		10	9.3	Hy
	17	7.9	R		6	10.4	Sp		9.7	3.8	R		7.7	6.2	R		11	9.6	R
	18	8.0	R		7	10.6	R		10.7	4.0	R		8.7	5.6	Mu		11	9.3	Hy
	19	7.9	R		8	10.8	L		11.7	4.2	R		9.5	5.6	O		12	9.5	R
	20	7.8	R		8	10.9	R		12.7	4.4	R		9.7	5.7	Mu		12	9.3	Hy
	22	7.8	R		10	10.9	R		13.7	4.4	R		9.7	6.0	R		13	9.4	Hy
					11	11.2	R		14.7	4.5	R		10.5	5.7	O		14	9.6	R
	194048				12	11.4	R		15.7	4.2	R		10.7	6.0	Mu		15	9.6	R
	RT Cygni				13	11.0	M		16.7	3.7	R		10.7	6.5	R		16	9.6	R
6	3	9.0	R		13	11.4	R		17.7	4.1	R		10.9	5.6	R		17	9.6	R
	4	9.1	R		14	11.3	R		17.9	4.4	R		11.5	6.0	R		18	9.6	R
	6	8.9	R		15	11.4	R		18.7	4.3	R		11.7	5.6	R		20	9.3	Hy
	7	8.9	R		18	11.2	Sp		18.9	4.1	R		12.7	5.9	R		23	9.3	R
	10	8.9	R		31	11.6	M		19.7	4.1	R		13.7	6.2	R		24	9.3	R
	11	8.8	R	8	1	11.6	L						14.5	5.8	O		25	9.4	R
	12	8.8	R		10	11.8	Sp		195116				14.7	5.8	R		26	9.3	R
	13	8.9	R		11	12.0	B		S Sagittae				14.7	5.6	R		27	9.3	R
	14	9.4	R		11	11.9	Sp	6	12.9	5.2	R		16.7	5.6	O	7	2	9.5	R
	15	9.2	R		13	12.5	Ba		23.0	5.7	R		16.7	5.7	Mu		3	8.5	Bu
	16	9.6	R						30	5.6	Mu		16.7	5.7	R		3	9.4	R
	17	9.6	R		194632			7	2.7	5.7	R		17.5	5.5	O		4	9.4	R
	18	9.6	R		χ Cygni				3.8	5.6	R		17.7	5.8	R		5	9.5	R
	23	9.8	R	6	7	10.2	Hy		4.7	5.6	R		17.9	5.6	R		7	9.5	R
	24	10.2	R	7	16	12.2	E		5.7	5.7	R		18.7	5.6	R		8	9.6	R
	25	10.2	R		24	11.0	B		5.9	5.7	R		18.9	5.6	R		9	9.3	R
	26	10.2	R	8	13	12.5	Ba		6	5.6	Mu		19.7	5.6	R		10	9.3	R
	27	10.2	R		15	11.0	M		7.7	5.8	R		22.7	6.3	R		11	9.3	R
7	2	10.5	R						7.9	5.8	R	9	6.5	6.0	O		11	8.7	Ma
	3	11.0	Bu						8.7	6.1	R		195849				12	9.4	R
	3	10.4	R		194700				9	6.1	Mu		Z Cygni				13	9.2	R
	4	11.2	M		η Aquilae				10.7	6.5	R	6	24	11.4	B		14	9.6	R
	4	10.4	R	6	12.9	4.0	R		10	5.7	Mu		30	11.7	Ly		15	9.3	R
	5	10.5	R		15.7	4.1	R		11	5.5	Mu	7	4	11.9	Ly		17	9.0	Ma
	7	10.6	R		16.7	4.1	R		11.7	6.3	R		18	12.5	Sp		18	9.3	R
	8	10.9	R		17.7	4.0	R		11.9	5.7	R		19	11.8	M		20	9.2	R
	9	11.1	Ba		18.7	4.2	R		12	5.7	Mu	8	13	12.5	Ba		22	9.0	M
	9	11.0	R		22.9	4.5	R		12.7	5.7	R		15	12.5	Sp		22	9.2	R
	10	11.1	R	7	2.7	4.5	R		13.7	5.7	R		200212				24	8.8	B
	24	11.9	Ba		3.7	4.0	R		13	5.5	Mu		SY Aquilae				24	8.8	Ba
8	11	10.8	R		4.7	3.9	R		14	5.6	Mu	6	16	11.4	L		27	9.4	R
	13	10.6	Ba		5.7	4.1	R		14.7	5.6	R	7	3	11.9	L		28	9.3	R
	15	11.0	M		5.9	4.2	R		15	5.6	Mu		13	12.0	M		30	9.4	R
	16	10.9	Sp		7.7	4.0	R		15.7	5.6	R		24	11.9	B		30	9.0	Ly
	17	10.7	Sp		7.9	4.2	R		16	5.9	Mu		24	11.9	Ba		31	9.4	R
	18	10.9	Ba		8.7	4.4	R		17	6.0	Mu		31	12.4	M	8	1	8.9	M
	30	9.8	M		10.7	4.1	R		18.7	5.7	R	8	1	12.0	L		2	8.7	Ma
					11.7	3.9	R		20.7	5.6	R		11	12.0	B		6	9.3	R
					11.9	4.0	R		22.7	5.6	R		14	12.0	Ba		7	9.5	R
	194604				12.7	4.1	R		27.7	6.0	R		200357				8	9.2	Ma
	X Aquilae				13.7	4.2	R		28.7	6.4	R		S Cygni				10	9.5	R
6	12	10.2	R		14.7	4.4	R		28.7	6.4	Mu	7	3	10.2	Bu		11	9.4	R
	15	9.8	R		15.7	4.3	R		29.7	6.0	Mu		200647				12	9.2	R
	16	10.3	R		18.7	4.1	R		30.7	5.7	Mu		SV Cygni				13	9.3	R
	16	10.2	L		20.7	4.0	R		30.7	5.9	R	6	3	9.4	R		14	8.1	Ba
	17	10.3	R		22.7	4.6	R		31.7	5.8	R		4	9.3	R		14	9.2	R
	18	10.4	R		27.7	3.8	R	8	1.7	5.6	Mu		6	9.8	R		14	9.0	Ma
	22	9.8	R		28.7	4.1	R		2.7	5.7	Mu		7	9.3	Hy		14	9.1	R
	26	10.5	B		30.7	4.6	R		3.7	5.6	Mu		7	9.8	R		16	9.1	R
7	2	10.5	R		31.7	4.3	R		4.7	6.1	Mu		7	9.8	R		17	9.1	R
	3	10.5	R	8	6.7	4.7	R		4.5	6.2	O						18	9.2	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

SV Cygni

Mo.	Day	Est.	Obs.
8	19	9.4	R
	20	9.4	R
	22	9.4	R

200715a

S Aquilae

6	12	10.1	R
	20	9.4	Hy
	22	10.0	R
7	2	10.5	R
	3	10.3	R
	4	10.4	R
	5	10.1	R
	7	10.1	R
	8	10.0	R
	10	9.9	R
	11	9.7	R
	12	9.7	R
	13	9.6	M
	13	9.6	R
	14	9.6	R
	15	9.7	R
	18	9.8	R
	20	9.9	R
	22	9.8	R
	24	9.5	B
	28	9.9	R
	30	9.8	R
	30	10.0	M
	31	9.9	R
8	6	10.3	R
	10	11.0	R
	11	10.0	B
	11	11.0	R
	12	10.8	R
	13	10.6	R
	14	10.3	R
	14	10.4	Ba
	15	10.4	R
	16	10.3	R
	17	10.3	R
	18	10.0	R
	19	10.1	R
	19	10.6	M

200715 b

RW Aquilae

6	12	8.7	R
	20	9.6	Hy
	22	8.9	R
7	2	9.1	R
	3	8.8	R
	4	9.0	R
	5	9.0	R
	7	8.9	R
	8	8.7	R
	10	8.7	R
	11	8.6	R
	12	9.0	R
	13	9.4	M
	13	8.8	R

RW Xquilae

Mo.	Day	Est.	Obs.
7	14	8.8	R
	15	9.0	R
	18	8.8	R
	20	8.8	R
	22	8.9	R
	24	9.2	B
	27	9.0	R
	28	8.9	R
	30	8.8	R
	30	9.2	M
	31	8.8	R
8	6	9.0	R
	7	9.1	R
	10	8.9	R
	11	8.7	R
	11	9.3	B
	12	8.9	R
	13	8.8	R
	14	8.7	R
	14	8.8	Ba
	15	8.7	R
	16	8.6	R
	17	8.7	R
	18	8.6	R
	18	9.2	M
	19	8.8	R
	22	9.2	R

200812

RU Aquilae

8	13	13.2	B
	14	12.8	Ba

200906

Z Aquilae

8	11	10.0	B
	14	10.4	Ba

200916

R Sagittae

6	12	9.1	R
	20	8.6	Hy
	23	9.0	R
7	2	9.3	R
	3	9.3	R
	4	9.4	R
	5	9.1	R
	7	9.4	R
	8	8.8	Hy
	8	9.5	R
	10	9.5	R
	11	9.3	R
	12	9.2	R
	13	9.3	R
	14	8.5	Hy
	14	9.3	R
	15	9.3	R
	18	8.7	Hy
	18	9.3	R
	20	9.3	R
	22	9.4	R
	24	9.1	B

R Sagittae

Mo.	Day	Est.	Obs.
7	27	9.4	R
	28	9.5	R
	30	9.6	R
	30	9.3	M
	31	9.7	R
8	6	9.9	R
	7	9.7	R
	10	9.9	R
	14	9.4	B
	11	9.7	R
	12	9.4	R
	13	9.3	R
	14	8.7	Ba
	14	9.3	R
	15	9.1	R
	16	9.1	R
	17	9.1	R
	18	9.0	R
	19	8.6	M
	19	9.0	R
	22	8.9	R

200938

RS Cygni

5	25	7.5	L
6	3	8.5	R
	4	8.5	R
	6	8.5	R
	7	8.5	R
	10	8.5	R
	11	8.6	R
	12	8.6	R
	13	8.6	R
	14	8.6	R
	15	8.6	R
	16	8.6	R
	17	8.6	R
	18	8.6	R
	23	8.4	R
	24	8.4	R
	25	8.2	R
	26	7.8	R
	27	7.6	R
7	2	7.7	R
	3	8.6	Bu
	3	7.7	R
	4	7.7	R
	5	7.8	R
	6	8.6	L
	7	7.1	R
	8	8.4	R
	9	8.5	R
	10	8.6	R
	11	8.5	R
	12	8.8	R
	13	8.7	R
	14	8.6	R
	15	8.7	R
	18	8.9	R
	18	8.8	Pi
	20	8.7	R

RS Cygni

Mo.	Day	Est.	Obs.
7	22	8.3	M
	25	8.5	M
	27	9.0	R
	28	9.0	R
	30	9.1	R
	30	8.6	Ly
	31	9.2	R
8	5	8.9	L
	6	9.1	R
	7	9.1	R
	10	9.1	R
	11	9.0	R
	12	9.2	R
	13	9.3	R
	14	7.9	Ba
	14	9.1	R
	15	8.7	Ma
	15	8.9	R
	16	9.1	R
	16	8.8	M
	17	9.1	R
	18	9.1	R
	19	9.1	R
	20	9.0	R
	22	9.2	R

201008

R Delphini

7	12	8.6	Pi
	16	8.8	Pi
	17	8.9	Ma
	29	9.0	B
8	4	9.5	Pi
	7	9.6	Ma
	9	9.8	O
	13	10.0	Pi
	14	10.2	Ba
	14	9.9	B

201130

SX Cygni

6	26	9.3	B
7	3	10.4	Bu
8	4	10.3	M
	15	10.1	M

201521

RT Capricorni

5	25	6.4	L
6	12	7.8	R
7	5	7.8	R
	8	8.0	R
	11	8.1	R
	11	6.6	L
8	6	8.4	R
	7	6.8	L
	7	8.1	R
	10	8.4	R
	11	8.4	R
	12	8.5	R
	13	8.5	R
	14	8.6	R

RT Capricorni

Mo.	Day	Est.	Obs.
8	14	7.0	Ba
	15	8.3	R
	16	8.0	R
	17	7.9	R
	18	7.8	R
	19	7.9	R

201647

U Cygni

5	25	11.1	L
7	3	8.8	Bu
	6	10.9	L
	22	9.2	M
	24	8.8	Ba
	30	10.3	R
	31	10.3	R
8	1	9.9	M
	5	10.8	L
	6	11.3	R
	7	11.1	R
	10	11.4	R
	11	11.6	R
	12	11.3	R
	13	11.6	R
	14	11.5	R
	14	8.0	Ba
	15	11.7	R
	16	11.6	R
	17	11.4	R
	18	11.6	R
	19	11.6	R
	20	11.4	R

202539

RW Cygni

6	7	8.5	Hy
	10	8.8	Hy
	11	8.6	Hy
	12	8.6	Hy
	13	8.7	Hy
	20	8.5	Hy
7	3	8.8	Bu
	3	9.0	R
	4	9.2	M
	4	9.2	R
	5	9.2	R
	7	9.1	R
	7	8.1	Hy
	8	9.1	R
	9	9.3	R
	10	9.3	R
	11	9.1	Ma
	11	9.4	R
	12	9.4	R
	13	9.4	R
	14	8.2	Hy
	14	9.4	R
	15	9.4	R
	15	8.3	Hy
	17	9.1	Ma
	18	8.2	Hy
	18	9.3	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

RW Cygni

Mo.	Day	Est.	Obs.
7	20	9.3	R
	21	9.0	Ly
	22	9.2	R
	24	8.3	Ba
	25	9.0	M
	27	9.2	R
	28	9.2	R
	30	9.2	R
	31	9.2	R
8	1	9.0	M
	6	9.4	R
	7	9.1	Ma
	7	9.3	R
	10	9.4	R
	11	9.3	R
	12	9.3	R
	13	9.3	R
	13	9.2	Ma
	14	9.3	R
	14	9.4	Ma
	14	8.4	Ba
	15	9.3	R
	16	9.0	Pi
	16	9.3	R
	16	9.2	M
	17	9.3	R
	18	9.3	R
	19	9.3	R
	20	9.3	R
	22	9.4	R

202817
Z Delphini

7	12	10.6	Pi
	31	9.0	V
8	6	9.4	V
	14	8.8	V
	14	9.2	Ba
	19	9.2	M
	30	9.0	V

202946
SZ Cygni

6	3	9.7	R
	4	9.5	R
	6	9.1	R
	7	9.1	Hy
	7	9.1	R
	10	9.3	Hy
	10	9.5	R
	11	9.4	Hy
	11	9.2	R
	12	9.3	Hy
	12	9.0	R
	13	9.3	Hy
	13	9.5	R
	14	9.4	R
	15	9.9	R
	16	10.0	R
	17	10.5	R
	18	10.0	R
	20	9.2	Hy

SZ Cygni

Mo.	Day	Est.	Obs.
6	23	9.5	R
	24	8.8	R
	25	8.9	R
	26	9.1	R
	27	8.9	R
	28	9.0	R
7	2	9.7	R
	3	9.7	Bu
	3	9.3	R
	4	10.5	M
	4	9.9	M
	5	9.9	R
	7	9.0	R
	8	9.4	Hy
	8	8.8	R
	9	8.7	R
	10	9.0	R
	11	9.2	R
	12	9.0	R
	13	9.6	R
	14	9.4	Hy
	14	9.6	R
	15	9.3	Hy
	15	10.0	R
	18	9.6	Hy
	18	9.4	R
	20	9.5	R
	22	9.9	R
	24	8.9	Ba
	24	8.7	B
	25	9.2	M
	25	9.0	Ba
	27	9.1	R
	28	9.4	R
	30	9.6	R
	31	9.7	R
8	6	9.0	R
	7	8.6	R
	7	8.9	Ba
	9	8.9	Ba
	9	8.9	R
	10	9.0	Ba
	10	9.0	R
	11	9.0	R
	12	9.2	R
	13	9.7	R
	13	9.5	Ba
	14	9.5	R
	14	9.7	Ba
	15	9.6	R
	16	10.5	M
	16	9.9	Ba
	16	10.1	R
	17	10.0	Ba
	17	9.8	R
	18	10.0	Ba
	19	9.9	Ba
	19	9.9	R
	20	9.7	R
	22	9.9	R

SZ Cygni

Mo.	Day	Est.	Obs.
8	23	8.8	Ba
	30	9.8	Ba

202954
ST Cygni

7	3	11.5	Bu
	12	13.2	B
	23	12.5	B
	25	11.5	Ba
8	4	11.8	M
	14	12.0	Ba

203611
Y Delphini

7	29	11.0	B
8	14	10.3	Ba
	17	10.7	B

203816
S Delphini

7	10	10.0	M

203817
Z Delphini

7	10	11.2	M

203847
V Cygni

6	24	10.8	B
7	3	11.5	Bu
	25	11.6	Ba
8	4	10.6	M
	15	10.2	Ba
	25	9.9	M
	30	9.7	M

204016
T Delphini

7	10	10.3	M
	18	10.6	Ba
	24	9.5	Ba
	30	9.8	M
8	14	9.1	Ba
	17	9.4	M

204318
V Delphini

7	11	12.1	M
8	14	12.7	Ba

204405
T Aquarii

7	18	10.7	Ba
	25	10.0	Ba
8	11	9.3	R
	12	9.4	R
	13	9.0	R
	14	8.9	R
	14	8.5	Ba
	15	8.9	R
	16	8.8	R
	17	8.2	B
	17	8.3	Pi
	17	8.8	R

T Aquarii

Mo.	Day	Est.	Obs.
8	18	8.7	R
	19	8.8	R

204846
RZ Cygni

7	3	10.8	Bu
	25	9.6	M
	25	11.0	Ba
8	4	10.3	M
	15	11.2	Ba

205017
X Delphini

7	3	10.4	Bu
	29	9.1	B
8	14	8.9	B
	14	8.7	Ba

205923
R Vulpec.

7	5	8.8	R
	7	8.6	R
	8	8.5	R
	10	8.3	R
	11	8.3	R
	12	8.4	R
	13	8.2	R
	14	7.2	R
	15	7.2	R
	18	7.3	R
	20	7.1	R
	22	7.3	R
	27	7.6	R
	28	7.7	R
	30	7.7	R
	30	9.0	Ly
	31	7.8	R
8	6	8.3	R
	7	9.0	R
	10	8.6	R
	11	8.8	R
	12	8.7	R
	13	9.1	R
	14	9.0	R
	14	8.9	Ba
	15	9.4	R
	16	9.6	R
	17	9.2	R
	18	9.3	R
	19	9.3	R

210129
TW Cygni

7	3	9.8	Bu
8	14	10.6	V
	14	10.1	Ba

210116
RS Capric.

6	12	8.8	R
7	5	8.6	R
	7	8.7	R
	11	9.0	R
	14	8.2	M

RS Capric.

Mo.	Day	Est.	Obs.
8	6	8.4	R
	7	8.1	R
	10	8.4	R
	11	8.4	R
	12	8.5	R
	13	8.7	R
	14	8.8	R
	14	8.0	Ba
	15	8.8	R
	16	8.9	R
	17	8.8	R
	18	8.7	R
	19	8.7	R

210868
T Cephei

6	11	10.0	L
	20	10.5	Hy
	28	9.6	M
7	6	9.6	L
	8	9.6	Hy
	8	8.8	R
	9	9.1	R
	10	8.6	R
	11	8.7	R
	12	8.7	R
	13	8.6	R
	14	8.5	R
	15	8.5	R
	16	9.3	Hy
	18	8.7	R
	20	8.7	R
8	6	8.2	R
	7	8.3	Ma
	7	8.0	R
	9	8.1	M
	10	8.0	R
	11	8.1	R
	12	8.0	R
	13	8.0	R
	14	7.9	R
	14	8.1	Ba
	15	8.1	Ba
	15	8.2	Ma
	16	8.1	R
	17	8.0	L
	17	7.8	R
	18	8.1	R
	19	8.1	R
	20	8.1	R
	22	8.1	R

211615
T Capric.

5	15	11.4	L
7	11	9.7	L
8	7	11.3	L

211614
X Pegasi

8	14	9.7	Ba

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

213244 W Cygni

Mo.	Day	Est.	Obs.
5	25	6.0	L
6	11	5.6	L
	12	6.1	R
	14	6.1	R
	15	6.0	R
	16	6.0	R
	17	6.1	R
	18	6.0	R
	22	6.1	R
	23	6.3	R
	24	6.5	R
	25	6.6	R
	26	6.7	R
	27	6.8	R
7	2	6.6	R
	3	7.0	Bu
	3	6.5	R
	4	6.4	R
	5	6.3	R
	6	5.9	L
	7	6.3	R
	8	6.4	R
	9	6.2	L
	9	6.3	R
	10	6.3	R
	11	6.5	R
	12	6.2	R
	13	6.3	R
	14	6.3	R
	15	6.3	R
	18	6.5	R
	20	6.5	R
	22	6.6	R
	27	6.5	R
	28	6.4	R
	30	6.4	R
	31	6.3	R
8	5	5.8	L
	6	6.4	R
	7	6.5	R
	8	5.8	L
	10	6.6	R
	11	5.6	L
	11	6.7	R
	12	6.5	R
	13	6.6	R
	14	6.4	R
	15	6.1	R
	16	6.1	R
	17	6.0	R
	18	6.0	R
	19	6.0	R
	20	6.1	R
	22	6.1	R

213678 S Cephei

Mo.	Day	Est.	Obs.
6	28	10.2	M
8	14	11.7	Ba

213753 RU Cygni

Mo.	Day	Est.	Obs.
6	27	8.7	M
7	3	9.2	Bu
	10	8.9	M
	25	8.9	Ba
8	15	8.8	M
	16	8.7	Ba

213843 SS Cygni

Mo.	Day	Est.	Obs.
5	25	8.9	L
6	11	12.1	L
	16	12.0	L
	22.9	10.0	R
	23.7	9.5	R
	24.7	9.1	R
	25.7	9.0	R
	26.7	9.5	R
	27.7	9.1	R
7	1.6	9.0	Ly
	2.7	9.1	R
	3.6	9.6	Bu
	3.7	9.5	R
	4.6	11.5	M
	4.7	9.9	R
	5.7	11.1	R
	5.9	11.2	R
	6	10.9	L
	6.5	11.6	Pi
	6.6	11.2	Ba
	8	11.5	L
	8.5	11.6	Ba
	8.6	11.7	Pi
	9	11.9	L
	9.5	11.6	Ba
	10.5	11.7	Pi
	10.6	11.8	M
	12.5	11.6	Ba
	12.6	11.6	E
	13.7	12.0	M
	13.6	11.8	E
	14.5	11.6	Ba
	16.6	11.9	E
	17.6	11.6	Ly
	17.6	11.9	E
	18.6	11.4	Sp
	18.6	11.6	Ba
	20.6	12.0	E
	22.8	11.7	E
	23.4	11.9	B
	24.5	12.0	Ba
	25.5	12.0	Ba
	30.6	11.8	Ly
	31.6	12.0	B
	31.7	12.0	M
8	4.6	12.0	M
	5	11.9	L
	6	11.8	L
	6.6	11.9	E
	7	11.8	L
	7.5	12.0	Ba

SS Cygni

Mo.	Day	Est.	Obs.
8	8	11.8	L
	8.6	11.8	E
	9	11.8	L
	9.5	11.8	Ba
	9.8	11.7	E
	10	11.8	L
	10.5	11.8	Ba
	11	11.7	L
	11.6	12.2	B
	11.6	11.8	E
	13.5	11.7	Ba
	13.6	12.2	B
	14.5	11.8	Ba
	14.6	12.0	B
	15.2	11.9	Sp
	16.2	11.7	Sp
	17	10.3	L
	17.5	10.7	B
	17.5	10.5	O
	17.5	10.9	Ba
	17.6	11.0	E
	17.6	10.4	M
	17.7	10.2	R
	17.9	10.2	R
	18.2	10.3	Sp
	18.5	10.3	B
	18.5	10.0	Ba
	18.6	10.1	E
	18.6	10.1	M
	18.7	9.3	R
	18.9	10.1	R
	19.5	9.5	B
	19.5	9.5	Ba
	19.7	9.6	R
	19.8	9.5	E
	19.9	9.7	M
	20.5	9.2	B
	20.7	8.9	R
	21.6	8.6	E
	22.7	8.9	R
	22.8	8.3	M
	23.5	8.5	Ba
	23.6	8.3	E
	24.5	8.4	B
	24.6	8.2	M
	25.5	8.6	B
	25.5	8.0	M
	25.6	8.3	E
	26.5	8.5	B
	27.5	8.5	B
	30.5	8.6	B
	30.5	8.5	Ba
	30.5	8.3	M
	30.9	8.4	M
9	6.5	10.3	O

213937 RV Cygni

Mo.	Day	Est.	Obs.
5	25	6.3	L
6	16	7.5	R

RV Cygni

Mo.	Day	Est.	Obs.
6	17	7.5	R
	18	7.5	R
	22	7.7	R
	24	7.5	R
	25	7.5	R
7	2	7.6	R
	3	8.8	Bu
	3	7.6	R
	4	7.6	R
	5	7.6	R
	6	6.4	L
	7	7.7	R
	8	8.2	Ly
	8	7.8	R
	9	7.8	R
	10	6.7	M
	10	7.8	R
	11	7.1	Ma
	11	7.8	R
	12	7.8	R
	13	7.9	R
	14	7.9	R
	15	8.0	R
	17	7.0	Ma
	18	8.0	R
	20	7.9	R
	22	8.0	R
	24	7.0	Ba
	25	7.9	M
	27	8.0	R
	28	7.9	R
	30	7.8	R
	30	8.0	Ly
	31	8.1	R
8	4	7.6	Ma
	6	8.0	R
	7	6.3	L
	7	7.7	Ma
	7	8.1	R
	10	8.1	R
	11	8.1	R
	12	8.2	R
	13	8.2	R
	14	7.9	Ma
	14	8.3	R
	15	8.3	R
	15	8.2	M
	16	7.1	Ba
	16	8.3	R
	17	8.4	R
	18	7.3	Ma
	18	8.4	R
	19	8.4	R
	22	8.4	R

214024 RR Pegasi

Mo.	Day	Est.	Obs.
7	6	13.4	Sp
	14	10.9	M
8	8	11.0	M

RR Pegasi

Mo.	Day	Est.	Obs.
8	10	10.9	Sp
	11	10.9	Sp
	13	11.1	M
	15	10.4	Sp
	16	10.8	Ba
	16	10.3	Sp
	17	10.2	Sp

215934 RT Pegasi

Mo.	Day	Est.	Obs.
8	16	11.3	Ba

220412 T Pegasi

Mo.	Day	Est.	Obs.
7	14	8.6	M

222439 S Lacertae

Mo.	Day	Est.	Obs.
8	13	10.2	Ba

222557 δ Cephei.

Mo.	Day	Est.	Obs.
6	3.7	3.9	R
	4.7	4.3	R
	6.7	4.1	R
	7.7	3.8	R
	10.7	3.4	R
	11.7	3.7	R
	12.7	4.0	R
	12.9	4.1	R
	13.7	3.9	R
	14.7	3.4	R
	15.7	3.7	R
	16.7	3.9	R
	17.7	4.1	R
	18.7	4.2	R
	23.0	3.6	R
	23.7	3.9	R
	24.7	3.8	R
	25.7	3.4	R
	27.7	3.9	R
7	2.7	3.9	R
	3.8	4.0	R
	4.7	4.1	R
	5.7	3.9	R
	5.9	3.7	R
	7.7	3.9	R
	7.9	3.8	R
	8.7	4.0	R
	9.7	4.1	R
	10.7	4.1	R
	11.7	3.4	R
	11.9	3.4	R
	12.7	3.5	R
	13.7	4.1	R
	14.7	4.3	R
	15.7	4.1	R
	18.7	4.0	R
	20.7	4.2	R
	22.7	3.8	R
	27.7	4.0	R
	28.7	4.2	R
	30.7	4.2	R
	31.7	4.3	R

VARIABLE STAR OBSERVATIONS June, July, Aug., 1915—Continued.

δ Cephei

Mo.	Day	Est.	Obs.
8	6.7	3.5	R
	7.7	4.0	R
	8.7	3.8	R
	9.7	4.0	R
	10.7	4.2	R
	10.9	4.1	R
	11.7	4.3	R
	12.7	3.6	R
	13.7	3.8	R
	14.7	4.2	R
	15.7	4.3	R
	16.7	4.3	R
	17.7	3.5	R
	17.9	3.8	R
	18.7	3.9	R
	19.7	3.9	R
	20.7	4.1	R
	22.7	4.0	R

225914
RW Pegasi

Mo.	Day	Est.	Obs.
7	14	10.2	M
8	16	12.1	Ba
	17	11.2	Pi
	17	10.9	M

230110
R Pegasi

Mo.	Day	Est.	Obs.
7	11	10.4	M
	14	10.2	M
	17	10.6	Mu
8	2	10.4	Mu
	3	10.6	Mu
	6	11.6	E
	10	12.0	Ba
	14	11.0	M
	17	11.2	Pi
	18	11.2	Ba

230759
V Cassiop.

Mo.	Day	Est.	Obs.
7	6	12.0	Sp
	14	11.6	M
	24	12.0	Ba
	6	11.4	M
	10	10.9	Ba
	10	11.0	Sp
	11	11.1	Sp
	16	10.2	B
	16	10.4	Sp
	16	10.4	Ba

231425
W Pegasi

Mo.	Day	Est.	Obs.
7	14	8.5	M
8	6	9.5	E
	7	9.5	Ma
	14	9.5	V
	15	9.7	Ma
	16	9.6	Ba
	17	9.3	M
	30	9.8	V

231508
S Pegasi

Mo.	Day	Est.	Obs.
7	14	8.1	M
	16	8.0	E
8	6	8.4	E
	14	9.2	M
	16	8.4	Ba

233335
ST Androm.

Mo.	Day	Est.	Obs.
7	16	9.1	E
	18	9.1	Ba
	25	9.0	Ba
8	6	9.3	E
	7	9.3	Ma
	9	9.3	O
	9	9.4	Ba
	15	9.3	Ma
	16	9.5	Ba
	18	9.2	E
9	6	9.3	O

233815
R Aquarii

Mo.	Day	Est.	Obs.
7	6	9.0	R
	8	9.0	R
	11	8.9	R
8	10	7.1	Ba
	11	7.8	R
	17	7.0	Pi
	18	7.0	R

233956
Z Cassiop.

Mo.	Day	Est.	Obs.
8	19	11.3	E

233956
R Cassiop.

Mo.	Day	Est.	Obs.
8	1	8.8	M
	6	11.6	E
	16	11.2	B
	25	8.9	M

235525
Z Pegasi

Mo.	Day	Est.	Obs.
8	6	12.4	E
	10	13.3	Ba

235939
SV Androm.

Mo.	Day	Est.	Obs.
7	18	9.8	Ba
8	6	8.8	E
	18	8.0	Ba

No. of observations 3045; No. of stars observed 187; No. of observers 15.

Professor Harlow Shapley, of the Mt. Wilson Solar Observatory, to whom a number of our members are indebted for courtesies extended when we visited the laboratory in Pasadena, Cal., called our attention to the interesting variable 090151 V Ursae Majoris. This star has been constantly observed since by several members who have thereby rendered a service of special value.

The feature of special interest in this report is the wane of the Variable 154428 R Cor. Bor., which, thanks to the alertness of our observers, was observed as it began its decline in brightness after its long period of constancy. It is one of the most remarkable stars in the universe. At this writing it has begun to brighten again. Each observer should observe this star at every opportunity.

The recent rise of 213843 SS Cygni was well observed. The secretary is in receipt of valuable data concerning this Variable compiled by Mr. David A. Blencoe of Superior, Wis. His record indicates that since 1912 the period is fifty-seven days. Mr. Richter writes that on August 17 at 8:15 P. S. T. with excellent seeing, the variable presented a hazy or nebulous appearance.

Members are again urged to compare their observations carefully with those of other observers, and where discrepancies appear in the case of stars that are not especially red, great care should be used in the matter of the identity of the Variable. Only in this way can the reports render the full service for which they were intended.

The following members contributed to this report:—Messrs. Bancroft, Bouton, Burbeck, Eaton, Hay, Lacchini, Lindsley, Mach, McAteer, Mundt, Olcott, Pickering, Richter, Spinney, and Vrooman.

WILLIAM TYLER OLCOTT,
Corresponding Sec'y.

Norwich, Conn.
Sept. 10, 1915.

R Coronae Borealis and SS Aurigae.—The star R Coronae Borealis, 154428, is an object of especial interest, owing to its large and irregular variations. From November, 1908, to August, 1912, it changed from magnitude 6.0 to 13.0, the minima sometimes succeeding each other within a few weeks. The decrease was generally more regular than the increase. From September, 1912, to June, 1915, the light has been sensibly constant, magnitude, 6.0. Mr. Eaton has called attention to its diminution in light during the last few days. Mr. Bancroft found its magnitude 6.8 on July 24, and 6.9 on July 25. Mr. Campbell observed it here as magnitude 7.7 on August 13. Careful observations every evening are much to be desired.

Mr. Eaton also calls attention to SS Aurigae, 060547, which is now bright.

EDWARD C. PICKERING.
Director.

Harvard College Observatory
Bulletin 585.
Cambridge, Mass., U. S. A.
August 14, 1915.

A Vanished Star? The Star α Cancri.—This star was seen to be double by Sir John Herschel in 1820, with this mention: White and red.

It was observed in 1836 by Lamont: the position angle was then 327°.3 and the separation of the components was 11″.52.

In 1899, the position angle was found by Doolittle, to be 322°.9 and the separation 11″.28.

In 1902, Burnham gave 326°.4 and 10″.9.

In 1909, our colleague, M. Raymond at Antibes, observed this star and noted its components, bluish white and fawn-colored; he made a second observation of it in 1910 and its characteristics were the same. Telescope of 200 millimeters.

On the 5th and 11th of March 1915, having added an instrument of 330 millimetres to his arsenal of peace, he observed again, but without success: the companion was not visible.

His communication, received from Antibes, is as follows:—"I ought to describe to you an observation which I would like to have you verify with the aid of a larger instrument. The question is of the visibility of the companion of α Cancri, of the eleventh magnitude, given as red. I saw it in 1909 and 1910 and I noted it as fawn-colored. But on March 5th and 10th, this year, notwithstanding my best efforts, I was unable to catch a glimpse of this star, although with a more powerful instrument than used in 1909 and 1910. The star is probably a very long period variable."

The verification could not be made at Juvisy, the observatory being military occupied and the instruments being temporarily dismounted. Nor could it be made at the Paris observatory nor at that of Nice. M. Flammarion then appealed to the observatory at Marseilles, to the well known kindness of its able director, M. Bourget. His reply follows:—

"I have profited by the pleasant weather of these last few days to verify with the different telescopes of the observatory the interesting statement of M. Raymond of Antibes. I examined α Cancer.

1st. With the comet seeker ($0^m.16$) with M. Coggia. Neither of us saw anything. April 2nd, beautiful evening.

2nd. April 3rd. I observed this star with the Foucault telescope ($0^m.80$). Nothing, beautiful evening.

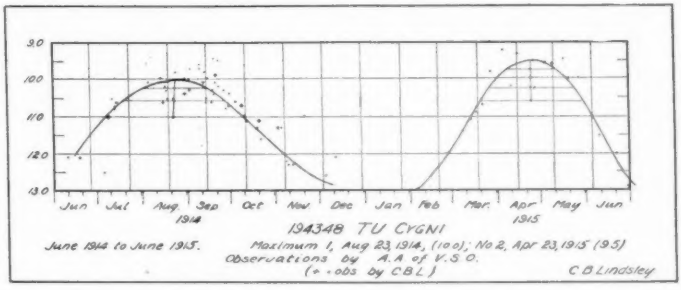
3rd. April 5th. I observed it with the Eichens Equatorial ($0^m.26$). Absolutely nothing. Beautiful evening.

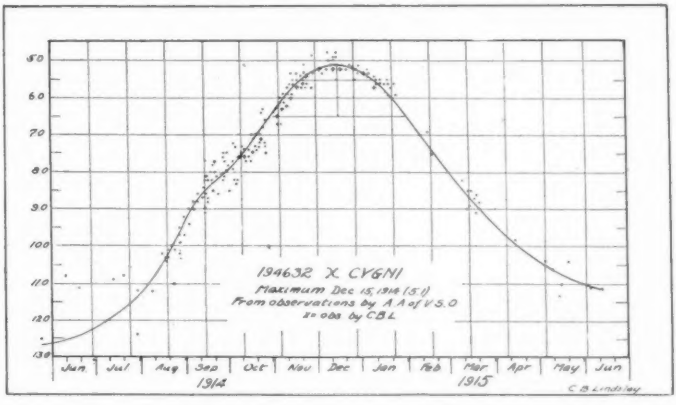
Therefore I have not been able to see the companion on any of these nights. M. Raymond's assertion seems fully justified to me."

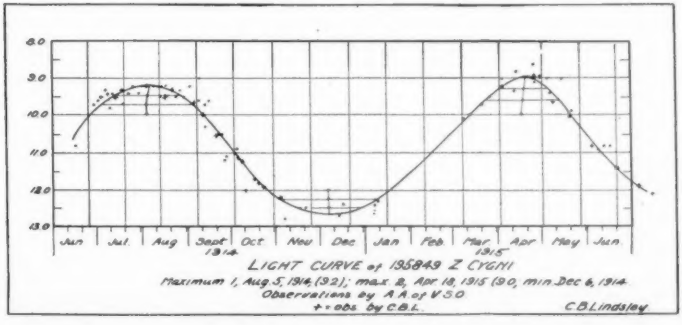
Is this companion variable? Has it entirely disappeared? These are interesting questions opened up by M. Raymond's observation.

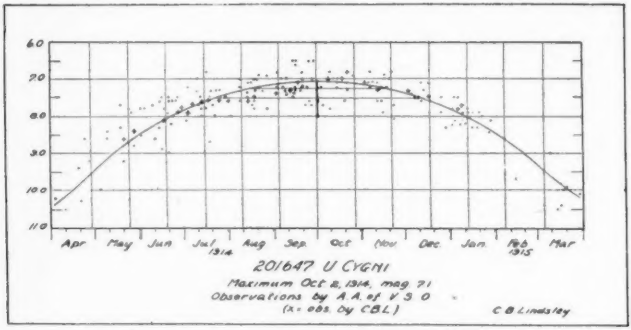
From *L'Astronomie.* May 1915.

Translated by Allen B. Burbeck.









GENERAL NOTES.

Professor G. Lecointe, director of the Royal Observatory of Belgium, at Uccle, near Brussels, is at present interned in Holland. He had served in the war as a major of artillery in the Belgian army, and took part in the retreat from Antwerp.

Dr. Franz Pingsdorf, director of the astrographic work in the Observatorio Nacional at Santiago, Chile, has resigned from that position.

Mr. Roscoe F. Sanford has been appointed Martin Kellogg Fellow at the Lick Observatory for the year 1915-1916. He will spend the year at Mount Hamilton.

M. Georges Van Biesbroeck, Adjunct Astronomer of the Royal Observatory, Uccle, Belgium, arrived on August 28 at the Yerkes Observatory, where he is to become a temporary member of the staff (for the academic year 1915-16) with the title of Visiting Professor of Practical Astronomy. He will work with the micrometers of the 40-inch and 12-inch telescopes on double stars, and will also take part in the regular stellar parallax work being done with the 40-inch telescope by the photographic method. During recent months, the first and last quarters of four nights per week have been assigned to obtaining plates for stellar parallaxes.

Frederick Campbell, Sc. D., former President of the Department of Astronomy, in the Brooklyn Institute of Arts and Sciences, now living at Beaver Falls, N. Y., is to lecture the third time at the Stone Boys' School, Cornwall Heights, N. Y., and for the second time at the Dobbs Ferry School, the Misses May's School in Boston, and the Rochester Theological Seminary, also before the Chicago Geographic Society and elsewhere. Among Dr. Campbell's new subjects are "Worlds in the Making"; "The Heavens Opened;" "A Peep into the Divine Workshop;" and "Brothers to the Sun." Dr. Campbell continues to contribute Astronomy and other science to various publications.

Astronomy in the High School.—While the statement has recently been officially made that Astronomy has entirely disappeared from the high school curriculum in New York state, this autumn happily witnesses the restoration of the subject in the Albany High School, an example which ought to be generally followed, not only throughout the state but throughout the country.

The Great Telescope at Potsdam, Germany.—The following extract from the latest report of the director of the Potsdam Observatory will doubtless interest many of our readers.

"It is well known that the objectives for the great telescope, the photographic of 80 cm diameter and the visual of 50 cm, were not satisfactory from the beginning and that in spite of repeated corrections, in the years 1901 to 1905, good images could not be obtained with the 80 cm objective. In 1911, Mr. B. Schmidt of Mittweida, who until then had produced only mirrors, was enabled through a government appropriation to obtain two disks of glass 38 cm in diameter, and with them to make his first objective. This objective had the same focal length as the 50 cm objective. It turned out to be good and fully competent to be substituted for the 50 cm objective for guiding purposes. After this experience the 50 cm objective was turned over to Mr. Schmidt for correction at the beginning of October, 1912. It was returned to the observatory by December of the same year. It is now a good objective giving round images with little diffused light and with small zonal errors.

"Meanwhile the Steinheil Company had made substantial progress in the manufacture of great objectives through their work on the 60 cm objective, for the Hamburg Observatory. Accordingly, in October 1913 the 80 cm objective on which they had already expended so much labor, was once more entrusted to them. It was returned after a year. This objective may now also be classed as a good one. The traces of the polishing tool have disappeared from the surfaces. Zonal errors and other irregularities still exist but their size has been reduced to about one third of their former amounts. According to extra-focal exposures made by Professor Wilsing by means of diaphragms, the diameter of the circle into which the light of a star is gathered has been reduced from 0.15 mm to 0.05 mm."

A Telescope Stolen.—One would think that an astronomical telescope would be the last thing a thief would think of stealing, but the unexpected sometimes happens. The July number of *Publication of the Astronomical Society of Pomona College* reports that on the night of May 10, 1915, the essential parts of the 6-inch telescope of the college observatory were taken and had not been returned at the time of issue of that publication. The parts taken were the objective, finder and one eye-piece, together with the brass cap which fits over the objective and the tube in which the eyepiece slides. The observatory was closed as usual after the evening's work was done on May 10 and on the next evening at dusk the loss was discovered. May 11 being "Mountain Day" everyone had been away all day and the observatory was closed until evening.

That the theft was not a "college prank" is the universal testimony of students and faculty. No provocation for such an act is known, and if there were, the telescope could be more easily put out of commission in other ways.

Purchasers should be on their guard against buying parts of a telescope of the above description from unknown parties.

A Correction.—The drawing of Jupiter published in POPULAR ASTRONOMY, Vol. XXIII, No. 7, August-September, 1915, should be dated June 3, at 15^h 55^m Central Standard Time instead of Greenwich Mean Time.

The Mount Strombo Observatory.—In the year 1910 the Government of Australia decided to define a spot within the Federal Territory (where the new capital is to be built), the meridian of which should be adopted as the prime meridian of Australia, to serve as the common longitude datum for all state surveys, and to mark the spot by erecting thereon a small astronomical observatory. The site selected was Mount Strombo. The building was erected, and a 9-inch refractor was installed in it. During 1912-13 a varied programme of observations was carried out to test the suitability of the site for more important work, and the results were so satisfactory that this provisional institution will probably soon be expanded into a first class observatory. (*Scientific American*, Aug. 21, 1915).

New Bausch and Lomb Observatory.—The first observational work to be done in the new Bausch and Lomb Observatory in Rochester N. Y., is being conducted during the month of September by Mr. Latimer J. Wilson, Director of the Planetary and Lunar Section of the Society for Practical Astronomy. The 11-inch Zeiss Refractor is being used for physical observations of Jupiter.

Telephone Time Service at the Sydney Observatory.—At Sydney, Australia, any telephone subscriber can now obtain correct standard time by calling up the Sydney Observatory. If he wishes merely to check his watch or clock, he asks for "Time", and is connected with an operator who reads off the correct time to the nearest half minute from a clock controlled by the standard clock of the observatory. If more accurate information is required, he asks for "Exact Time," and is connected with a high frequency buzzer which transmits the actual beats of the clock. This observatory had planned to inaugurate a wireless time service, but this undertaking has been postponed on account of the war. Sydney and Melbourne observatories have recently exchanged wireless longitude signals with each other and with several camps established by the government of South Australia—the first use of radio-telegraphy for this purpose in Australia. (*Scientific American* Sept. 4, 1915).

Radial Velocity of the Nebula N. G. C. 1068.—In *Publications of the Astronomical Society of the Pacific* No. 160 Mr. J. H. Moore gives the result of measurement of a spectrogram, obtained at Mount Hamilton Dec. 31, 1914, of the spiral nebula N.G.C. 1068, as +910 km per second. This falls between the velocities obtained for the same nebula by Mr. Slipher at the Lowell Observatory and Mr. Pease at the Mount Wilson Observatory. It is difficult to credit such enormous velocity in ponderable matter, yet to discredit it requires some other interpretation of the displacement of the spectral lines than that based on the Doppler-Fizeau principle. The three determinations of the radial velocity of this nebula are

Slipher	+1100 km
Pease	+765 "
Moore	+910 "

Proper Motion in Star Clusters.—An item has been going the rounds of the *Comptes Rendus*, *L'Astronomie*, and most recently in *Nature*, to the effect that M. Comas Sola, of Barcelona, had recently compared with an ordinary stereoscope two photographs of Messier 11 taken with a photographic doublet of about 32 inches focus; and that he reached the extraordinary conclusion that the proper motion of hundreds of stars could be thus detected on plates separated by

an interval as short as three years. This statement should be received with a great deal of skepticism. We know that the cluster Messier 11 and many others have been under observation by eminent observers, both micrometrically and photographically for a long period of years, and it has been almost impossible to establish positively a proper motion of any star. Mr. Barnard has given particular attention to this cluster for many years, and his measures come out with a wonderful accordance.

Radial Velocities of Five Hundred Stars.—In the *Astrophysical Journal* for September 1915 Mr. W. S. Adams gives the radial velocities for 500 stars, obtained with the 5-foot reflector of the Mount Wilson Observatory arranged as a Cassegrain spectrograph. The observing list included:

"1. A and B-Type stars, mainly between magnitudes 5 and 6.5, a knowledge of whose motions is of particular interest as aiding in the determination of the elements of the two principal star-streams.

"2. A, F, G, K, and M stars of magnitudes 5 to 6.5 which have very small astronomical proper motions. These may in general be considered as very distant stars of high luminosity, and are of interest as regards both their radial velocities and certain characteristics of their spectra.

"3. Stars with measured parallaxes, most of which have very large proper motions. The magnitudes of these stars are chiefly between 5.5 and 8.5."

The accuracy of the results for stars with sharp lines is indicated by the following comparison, for the stars α Böotis and α Tauri, of results obtained at the three great observatories:

Star	Mount Wilson	Lick	Yerkes
α Böotis	— 4.3 km	— 3.9 km	—4.5 km
α Tauri	+54.0	+55.1	...

The following stars were found to have radial velocities over 100 km per second when corrected for the sun's motion:

Star	Type	Velocity
AOε 14320	G0	+299 km
Boss 4188	Map	+112
W. B. 17^h514	F1	−131
A. Oε. 20452	G0p	−170

The Festival of the Sun.—The annual sun festival (*fete du soleil*) of the Astronomical Society of France, which has been held annually on the Eiffel Tower since 1904, on the evening of the summer solstice, was omitted this year on account of the war. Several Spanish members of the society, however, as well as other Spanish astronomers, held a sun festival of their own at the Fabra Observatory in Barcelona, the director of which, Senor J. Comas Solá, is well known for his solar investigations. It is likely that this event will hereafter be celebrated annually at Barcelona, as well as at Paris. (*Scientific American* Sept. 4, 1915.)

Conference of the Society for Practical Astronomy.—The second annual conference of the Society for Practical Astronomy was held at the University of Chicago on August 16, 17 and 18, 1915. Sixteen members were in attendance and a considerable number of papers was presented from absent members.

Officers nominated for the ensuing year are as follows:

President:	Latimer J. Wilson
Secretary:	Horace C. Levinson
Treasurer:	H. W. Vrooman
Other Councilmen	Frederick C. Leonard
	John E. Mellish
	R. Burnside Potter
	A. F. Kohlman

Ephemeris of Comet 1915 *d* (Mellish).—The following preliminary elements and ephemeris of Mellish's new comet, computed by Messrs. Einarsson and Alter, of the Student's Observatory, Berkeley, California, came to hand, in Bulletin 590 of Harvard College Observatory, just as the last form was ready to go to press. The elements depend upon observations September 18, 20 and 21 so that they are probably quite uncertain.

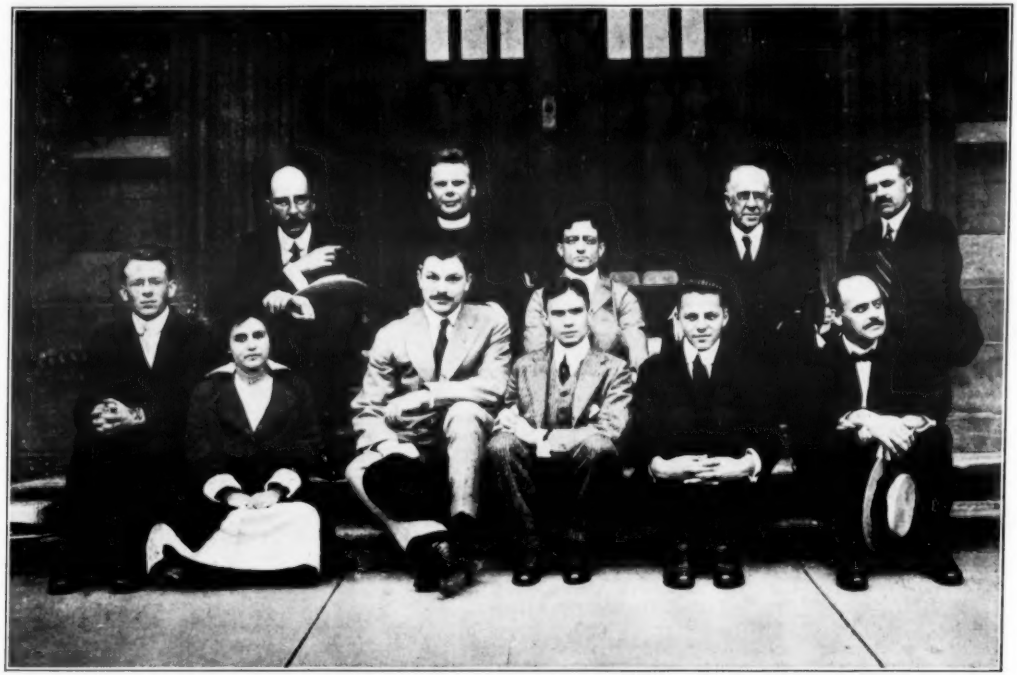
ELEMENTS

Time of perihelion passage	T	1915 Oct. 13.06 G.M.T.
Perihelion minus node	ω	115° 44′
Longitude of node	Ω	76 01
Inclination	i	51 59
Perihelion distance	q	0.469

EPHEMERIS

G.M.T.	R.A.	Dec.	Light
	h m s	° ′	
1915 Sept. 23.5	11 04 50	+24 32	1.41
27.5	11 37 23	21 54	
Oct. 1.5	12 09 52	18 32	
5.5	12 41 28	+14 26	2.25

PLATE XXII



MEMBERS OF THE SOCIETY FOR PRACTICAL ASTRONOMY AT THE UNIVERSITY OF CHICAGO

Top Row—R. Burnside Potter, Rev. A. Petrajtys, Prof. Homer F. Black, Rev. L. F. Bumpas, Wm. Henry.
Bottom Row—S. F. Maxwell, Miss Marguerite Mueller, C. A. Mundstock, F. C. Leonard, H. C. Levinson, H. W. Vrooman.